Rinnai

Tankless Water Heater Training Program

Level II –

Installation Fundamentals

Spring 2008

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Registration

Welcome To Rinnai's Tankless Water Heater Training Class

- Fill out the sign-in sheet (print legibly)
- Please take time to fill out the sign-in sheet completely
- Partner with the world's largest tankless water heater company
- Express your interest in becoming an Authorized Service Provider (ASP)

PRODUCT FEATURES

“UC” Model Number Change

➢**UC model number change – (R75LS and R94LS available October 2008)**
(R50LSi and R63LSe available January 2009)

- **Old** part number: REU–VA2528FFUD(A) –US– N
- **New** “UC” part number: REU–VA2528FFUD(A) –***“UC”***– N

Changes to the LS products to include two new features:

- ***Maximum default production temperature setting of 120º F (49º C)***
  - *Meets requirements of various local codes*
  - *Enhances safety of users, especially children and the elderly*
  - *Temperatures between 125 – 140º (52º - 60ºC) are available by setting dip switch 6 to the ON position in the SW1 bank of 8 dip switches*

- ***Ability to use a single MCC-91 controller for multiple banked units in a commercial application.***
  - *One MCC-91 connected in a series of banked units will control the temperature of all units and allow the temperature to go above 140º F (60º C).*
  - *Previous applications required one MCC-91 temperature controller for each unit in order to go above 140º F (60º C)*

Product Features

- Rinnai's LS series can be used in both residential and commercial applications
- Units are available as either natural or propane gas
- Residential installations are potable water applications only in single family dwellings with a maximum water temperature setting of 140ºF
- Commercial installations are potable water applications for restaurants, schools, hotels, car washes, coin laundries, assisted living facilities, etc. Hydronic applications are also defined as commercial installations.
  - The MCC-91 commercial temperature controller (optional) allows a maximum water temperature setting of 160º F on the R50LS, R63LS and R75LS models
  - The MCC-91 commercial temperature controller (optional) allows a maximum water temperature setting of 185º F on the R94LS and R98LS models

  DO NOT use these units in any application involving chemically treated water, (i.e. chlorinated pool water, hot tubs, etc,)

Product Features

- Whole house continuous hot water system when properly sized
- Endless hot water – never run out of hot water
- Thermal efficiency from 80% to 84% (depending on model)
- Energy factor rating of .81 to .84 (depending on model)
- Temperature controller for setting desired water temperatures
    - Output temperature can be adjusted to provide specific water temperatures for home, schools, nursing homes, hotels, etc..
- Space saving, compact size
- Direct electronic ignition (no standing pilot)
- Very low noise (49 decibels)
- All parts are replaceable
- †Life expectancy up to 15 – 20 years

†Actual performance life will vary depending on water quality, usage rates, environmental conditions, and required maintenance scheduling. Refer to the maintenance section of the operators manual for further details.

Safety Devices

- Maintenance / diagnostic codes are displayed on the temperature controller, simplifying service calls
- Safe, low voltage temperature controllers
- Flame rod indicator (validates and / or indicates flame failure)
- Over heat bi-metal sensor
- Boiling protection
- Heat exchanger thermal fuses
- Built-in freeze protection to -30º F (must have gas and electricity)
  - A drain down kit can be obtained to protect the unit from freezing in case of electrical failure or inadequate gas supply
- Combustion fan senses blocked intake or exhaust flue
- Surge protector built in-line with the power supply
- Power supply is protected by 3-amp glass fuse

LS Water Heater Model Specifications

For detailed specifications of each model, see Appendix A (pg. 93) in this manual or each models specification sheet.

Model Designation i=indoor models e=outdoor models	Model Number	Minimum Btu's	Maximum Btu's	Minimum Flow Rate (approx.)	Maximum Flow Rate 35° Temp Rise	Maximum Flow Rate 50° Temp Rise
V53e	REU-VAM1620W	20K - NG 19K - LPG	120K	0.6 GPM	5.3 GPM – 35º F	3.9 GPM – 50º F
R50LSi	REU-VA2019FFUD	15K	150K	0.6 GPM	5.0 GPM – 35º F	5.0 GPM – 50º F
R63LSe	REU-VA2024WD	19K	150K	0.6 GPM	6.3 GPM – 35º F	5.0 GPM – 50º F
R75LSi	REU-VA2528FFUD	15K	180K	0.6 GPM	7.5 GPM – 35º F	6.0 GPM – 50º F
R75LSe	REU-VA2528WD	15K	180K	0.6 GPM	7.5 GPM – 35º F	6.0 GPM – 50º F
R94LSi	REU-VA2535FFUD	15K	199K - NG 190K - LPG	0.6 GPM	9.4 GPM – 35º F	6.6 GPM – 50º F
R94LSe	REU-VA2535WD	15K	199K	0.6 GPM	9.4 GPM – 35º F	6.6 GPM – 50º F
R98LSi*	REU-VA3237FFUD	19K	237K	0.6 GPM	9.8 GPM – 35º F	7.9 GPM – 50º F
R98LSe*	REU-VA3237WD	19K	237K	0.6 GPM	9.8 GPM – 35º F	7.9 GPM – 50º F

*R98LS series models are available with or without an ASME rating. Certain states and local municipalities require an ASME rating for any appliance with a maximum input over 200,000 Btu

- States that do NOT require the R98LS ASME rated product: California, Florida, Massachusetts, New Jersey, New Mexico, Oregon, and Washington
- States that have local municipalities that require the R98LS ASME rated product: Colorado, Illinois, Louisiana, Minnesota, New York, Tennessee, Texas, and West Virginia
- All other states require the R98LS ASME rated product

Section Review

1. **Rinnai tankless water heaters have a standing pilot? True / False**

   False. *All Rinnai tankless water heaters have electronic ignition*

2. **In order for freeze protection to work correctly, Rinnai tankless water heaters must have which of the following:**

   A. Adequate Water Flow B. Incoming Electricity

   C. Adequate gas supply D. Answers B and C

3. **Which of the following is by definition a residential application?**

   A. A fast food restaurant with a maximum temperature setting of 130°

   B. A condominium where a single tankless water heater is providing hot water for three separate units

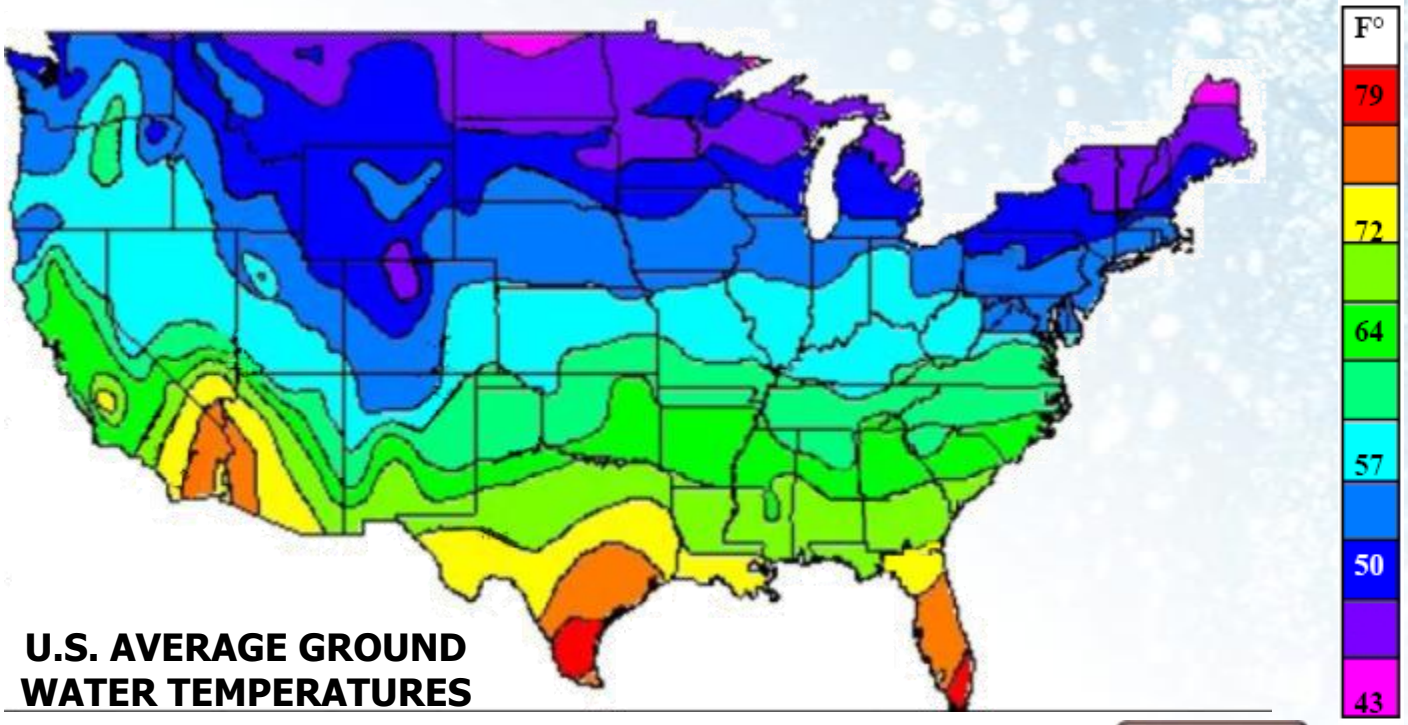
   C. A tankless water heater providing domestic hot water and hydronic heat in a single family dwelling

   D. A tankless water heater providing domestic hot water only

TANKLESS WATER HEATER SIZING

What is Delta T (ΔT)?

The difference of the incoming ground water and the tankless water heater's set point temperature is known as Delta T (ΔT). Delta T determines the flow rate of the tankless water heater.



U.S. AVERAGE GROUND WATER TEMPERATURES

EXAMPLE

Rinnai Tankless Water Heater's temperature at controller = 120°

Subtract the incoming temperature from the water heater's set temperature for ΔT: 120° - 57° = 63° ΔT

Understanding Maximum Flow Rate

The tankless water heater's first priority is to provide the set point temperature to the user. Based on the ΔT, the tankless product may regulate flow to ensure it can provide the selected temperature.

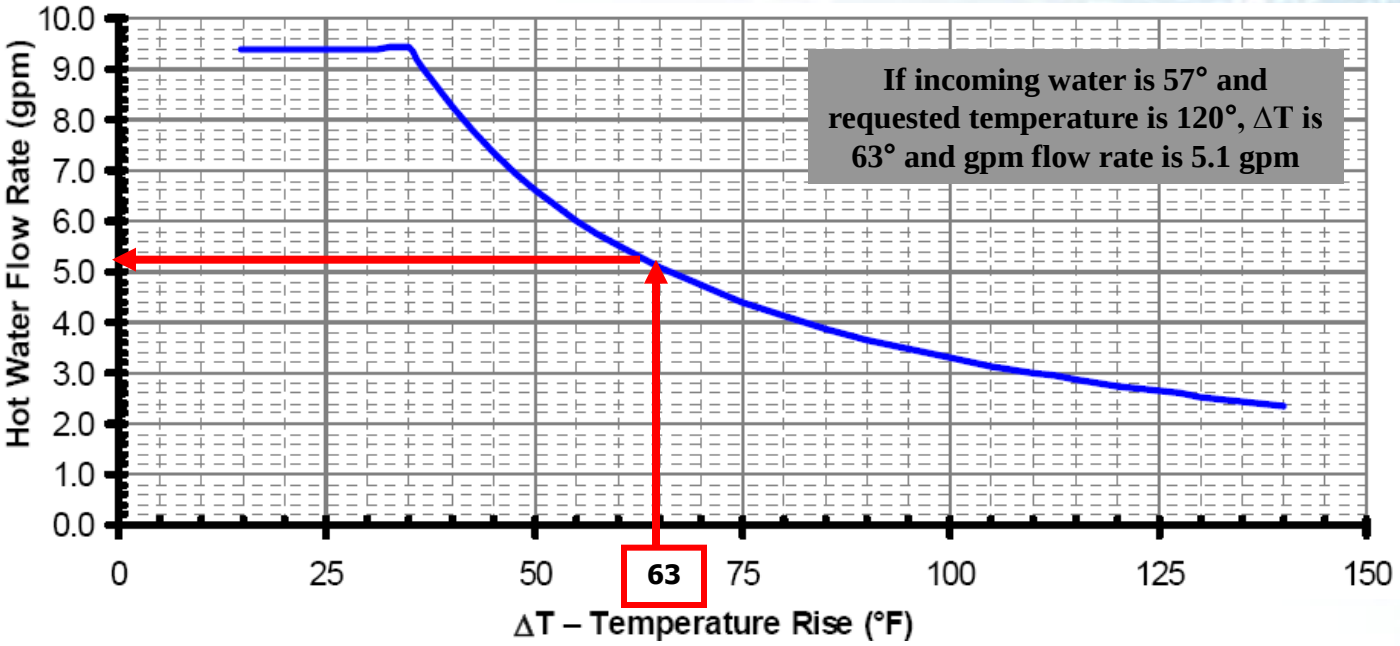
EXAMPLE (from previous page)

Incoming water = 57° **Rinnai Set-Point temperature = 120°**

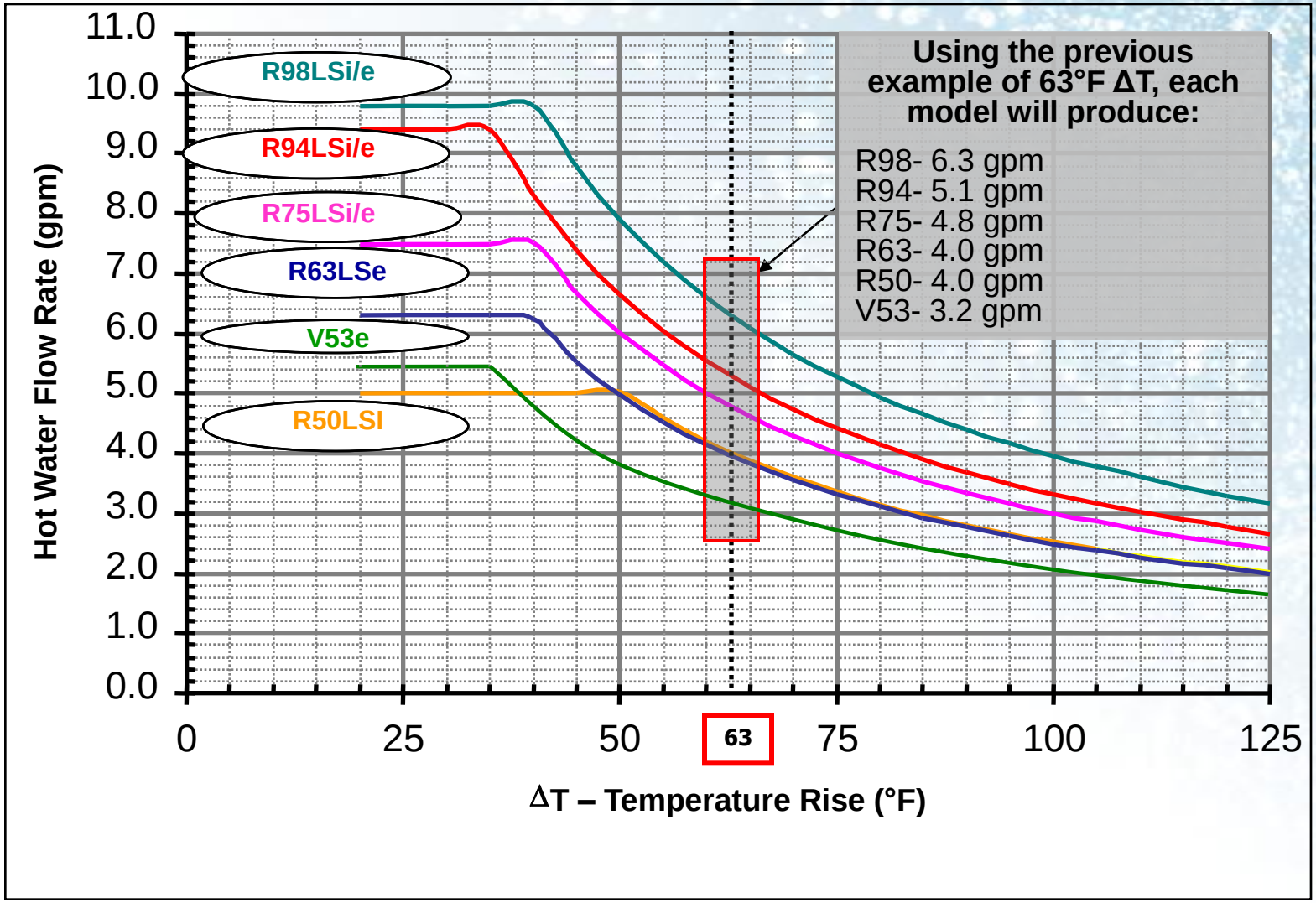
- **Subtract the incoming ground water temperature from the water heater's set temperature for ΔT 120° - 57° = 63**
- **The maximum GPM flow rate for any given ΔT can be found at the intersecting points along each model's specific flow curve**
- **A GPM flow test from the temperature controller can verify each unit's performance**

R94 LSe Flow Curve

Flow curves of each model are listed in each installation manual



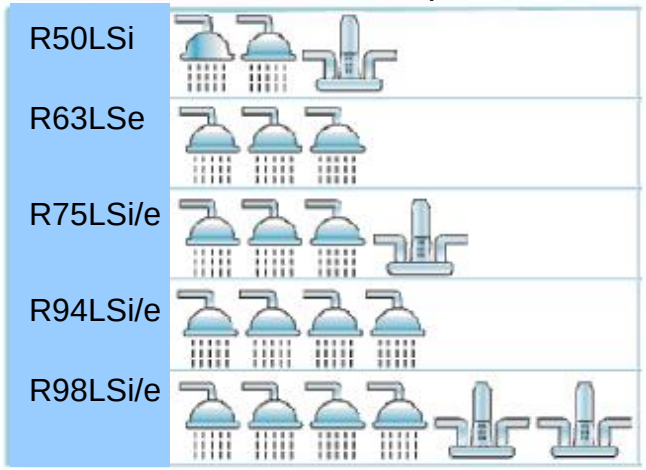
Maximum Flow Rate by Model



LS Whole-House Sizing Chart

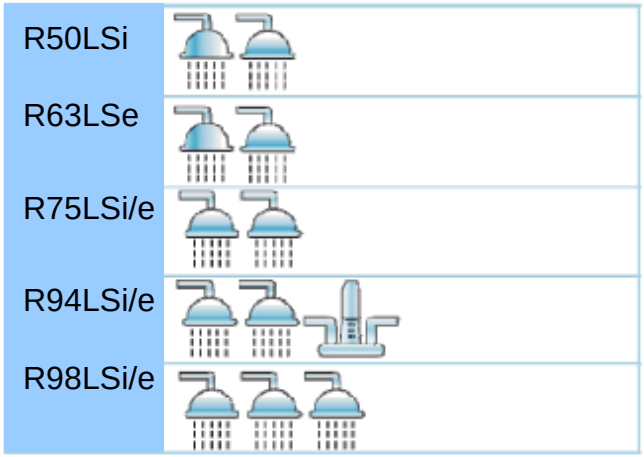
WHOLE HOUSE SIMULTANEOUS BATH USE

Summer Season – Ground Water Temperature: 65°-75° F



V53e models will supply the equivalent of two shower heads in the above temperature range

Winter Season – Ground Water Temperature: 45°-55° F



V53e models will supply the equivalent of one shower head in the above temperature range

- A residential washing machine or dishwasher is equivalent to one shower head
- Shower heads assumed to be 2.5 gpm mixed flow rate or less.
  - 2.5 gpm is a standard size for most residential shower heads
  - If multiple shower fixtures (i.e. body sprays, large rain heads, or tubs over 60 gallons in capacity) are used, please contact Rinnai's applications and sizing group
- Bathroom sink faucets assumed to be 2 gpm mixed flow rate or less.
- Assumed mixed temperature on shower heads and bathroom faucets are set to 104º F
- Assumed Rinnai water heater set point at 120º F
- Assumed 50 psi – 80 psi inlet water pressure for maximum flow

Section Review

1. **The tankless water heater's first priority is:**

   A. Maximum Flow B. Set point temperature

   To ensure set point temperature, the tankless water heater can reduce flow

2. **Delta T (ΔT) is the difference between the water heater's set point temperature and incoming water (groundwater). True/False**

   True. *This can affect the water heater's output GPM.*

3. **Which of the following can determine Delta T (ΔT):**

   A. Geographic location (including altitude)

   B. Set point temperature of the water heater

   C. Season of year (summer, winter, etc.)

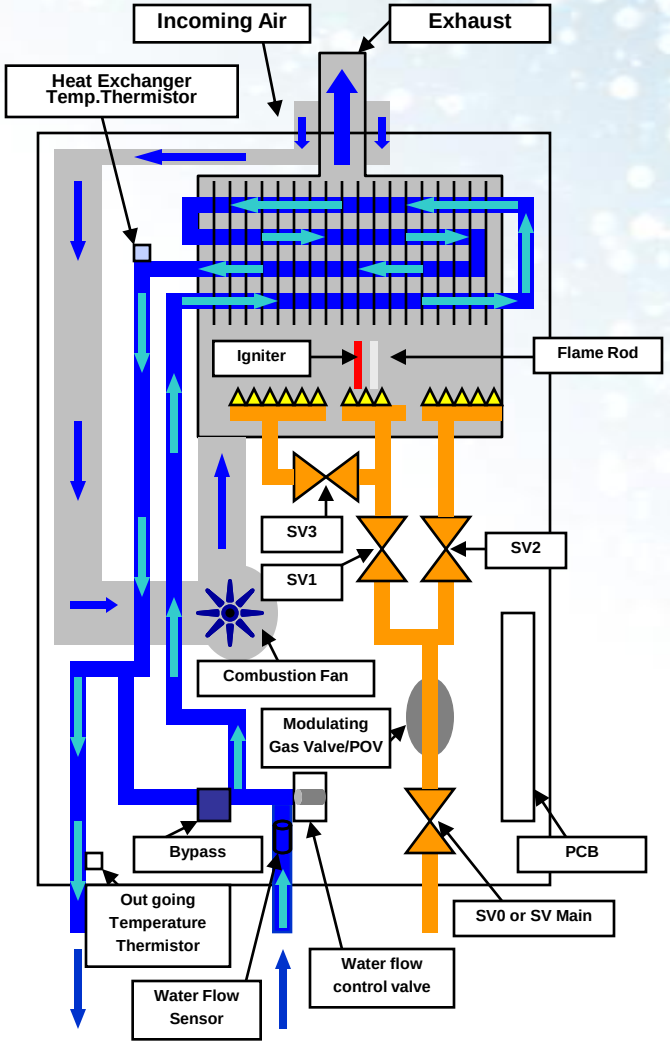
   D. Source of water supply (municipal as compared to well water)

   E. All of the above

   Along with set point temperature, any factor contributing to incoming water temperature will affect Delta T (ΔT).

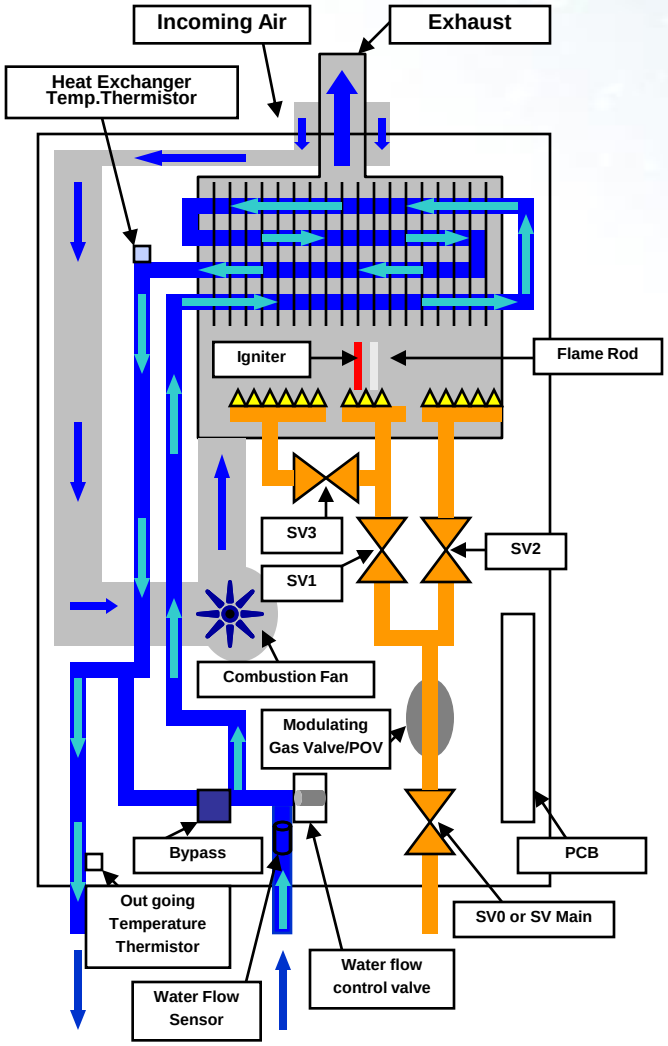
SEQUENCE OF OPERATION

Sequence of Operation



Indoor LS Unit

Sequence of Operation (indoor LS unit)



1. Water flow begins

- Water flow sensor sends pulses to the PCB
- When flow exceeds approximately .6***** gpm. the ignition sequence begins.
  ***Model specific depending on BTU rate.**

2. Ignition Sequence

- Combustion fan turns to allow correct air flow thru unit
- Spark igniter begins sparking
- Gas control valve opens to minimum fire rate
- When flame rod proves ignition spark igniter stops sparking

3. Normal Operation

- PCB monitors flame rod, fan motor frequency, outlet water temperature, temperature set point, and water flow rate
- POV gas valve & fan speed modulate gas and air input to meet user demand
- Water is heated as it passes thru heat exchanger multiple times
- Heat exchanger strategically overheats water while the fixed or variable bypass cools to the set point temperature to provide higher flow rates
- Water flow control valve is adjusted, as needed

4. Shut-down Sequence

- PCB senses flow rate less than .5 gpm
- Gas control valve closes & water flow control valve resets to standby position
- Combustion fan runs for a short period of time at low speed

5. Standby Mode

- PCB monitors all components. Freeze protection is activated as needed

INSTALLATION REQUIREMENTS

Structure / Home Definitions

- **Define Multifamily Housing –**
  - A typical multifamily home is considered to be a building containing two or more units (NAHB.2002), with an average square footage of 1,115 square feet[1].
  - Congress defines multifamily housing as “any project with four or more units that includes condominiums, apartments and single-story units[2].
  - Any Rinnai tankless water heater supplying more than a single family dwelling will be considered a commercial installation and thus carry a commercial warranty.
- **Define Mobile Home –**
  - A structure that is transportable, detached, single-family dwelling that is a person’s principle residence and contains by-design the normal amenities for continuous year-round occupancy.
- **Define Modular Home –**
  - A home that is built inside or at a factory and then transported to the site. These structures conform to all local, state and regional codes where the structure is to be located.
- **Define Indoor –**
  - Within the confines of a structure, typically a home and or dwelling that is habitable. Carports and crawlspaces must use indoor models.
- **Define Outdoor –**
  - Any location that is outside a structure or dwelling. This would include under a deck. (Decks must be open on three sides).

[1] - NAHB 2002 / [2] - www.fairhousing.vipnet.org

Installation Requirements

It is very important to ensure the following incoming sources are within specification:

- **Electricity –**
  - A properly polarized and grounded 120 VAC, 60 Hz supply is required. Temperature controllers operate on 12 VDC only supplied by the water heater.
- **Water –**
  - Water pressure, pipe sizing, and water quality must meet the EPA's National Secondary Drinking Standards
- **Gas –**
  - Adequate gas pressure and volume (gas line sizing) must be verified for proper operation
- **Venting (air) –**
  - Vent components that are certified and listed with the water heater model must be installed to specifications and proper clearances must be maintained
- **Code Adherence –**
  - All national, state, and local codes must be followed

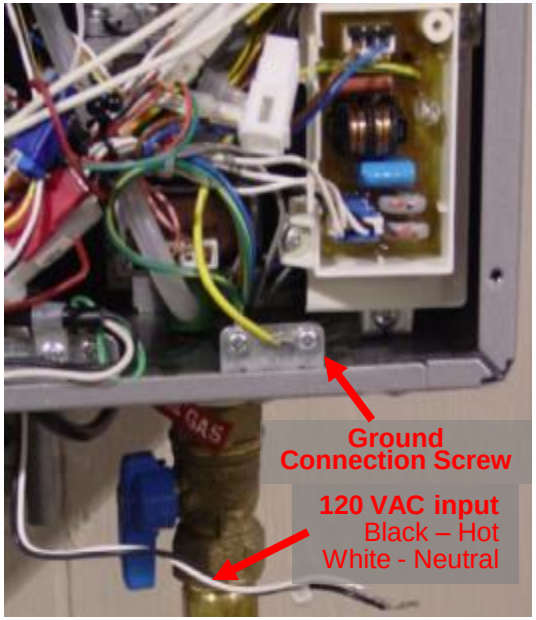
Pre – Installation Check-List

- ☑ Ensure the gas supply is properly sized. Refer to the Installation Manual.
  - ☑ All gas meters, regulators, gas line types, tanks, utility provider, etc. should have the correct BTU volume
  - ☑ Confirm that all external gas components meet the gas requirements at the point of installation
- ☑ Ensure the proper gas type and pressure is supplied to the unit(s). Refer to the water heater's rating plate
- ☑ Ensure the gas supply pipe is purged of foreign material before connection
- ☑ Verify the clearances around the unit's vent and air intake will meet manufacturer and all code requirements (see Installation Manual)
- ☑ Ensure installation of isolating valves, union & drain down valves on the cold water inlet line & hot water outlet lines (these components are used for servicing and removing the appliance quickly)
- ☑ Ensure a pressure relief valve is installed with a rating that equals or exceeds the Btu input of the water heater model. Refer to the rating plate on the side of the appliance for Btu input (see Installation Manual).
- ☑ Ensure 120 Volts A.C. is available to the unit per national, state and local codes and that the unit will be properly grounded with the correct polarity

Installation Requirements

ELECTRICAL REQUIREMENTS

Outdoor Models

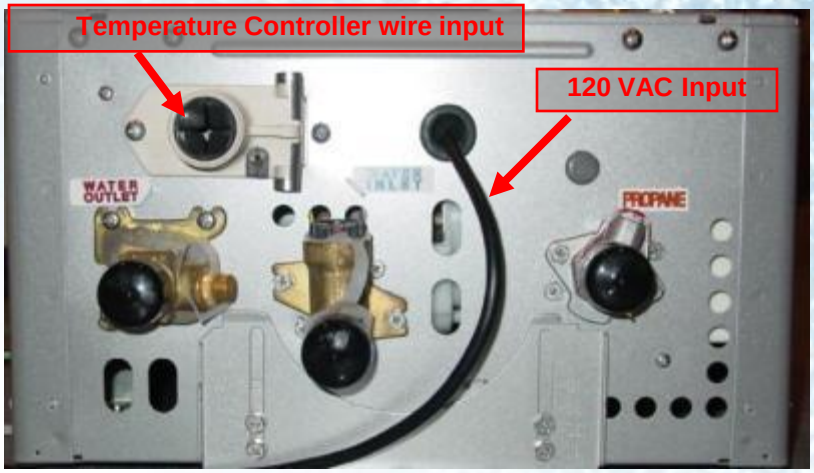


External units come with a hot and neutral wire and a ground connection point for direct connection to supply (i.e. circuit breaker box). Ensure supply is properly polarized and grounded 120 VAC.

Indoor Models

Internal units come with a standard three-prong appliance cord. Ensure receptacle is properly polarized and grounded 120 VAC.

Entry point for electrical connections



Supply power should enter the water heater through the center opening at the bottom of the unit

Temperature controller wire should enter the water heater through the left opening at the bottom of the unit.

Important:
Observe all applicable electrical code. Circuit must be well grounded to earth for proper operation of the water heater.

Installation Requirements

WATER REQUIREMENTS

- **WATER PRESSURE**
  - Minimum water pressure 20 psi
  - Maximum water pressure 150 psi
  - Rinnai recommends 30-80 psi for optimum performance
  - ANSI Code requires the addition of an approved pressure relief valve
    - Valve must be rated No-More than 150 psi and No-Less than the water heater's maximum Btu input

- **INCOMING PIPING REQUIRMENTS**
  - All performance data of Rinnai Water Heaters are based on systems plumbed with ¾" pipe (unless otherwise noted). Performance may vary with other pipe sizes.

- **WATER QUALITY**
  - For proper operation, unit longevity, and warranty adherence, water quality cannot exceed the parameters set forth by the EPA's National Secondary Drinking Standard's Act:

DESCRIPTION	pH	TDS (Total Dissolved Solids)	Total Hardness	Aluminum	Chlorides	Copper	Iron	Manganese	Zinc
MAXIMUM LEVELS	6.5 to 8.5	Up to 500 mg/L	Up to 200 mg/L (11.7 gpg)	Up to 0.2 mg/L	Up to 250 mg/L	Up to 1.0 mg/L	Up to 0.3 mg/L	Up to 0.05 mg/L	Up to 5 mg/L

*See Appendix B (pg. 107) for additional water quality information

Gas Piping

- Gas – General Instructions
  - A manual gas control valve must be installed in the gas supply line prior to the unit.
  - An easy means of disconnection (such as a union) should be above the shut-off valve for future servicing of the water heater.
  - Supplied gas pressure must be within the limits shown on the rating plate or specification section listed for each product.
  - Before operating the unit, all joints including the water heater must be checked for gas tightness by means of leak detector solution, soapy water, or equivalent nonflammable solution, as applicable.
  - The gas supply line shall be gas tight, sized, and so installed as to provide a supply of gas sufficient to meet the maximum demand of the water heater and all other gas consuming appliances at the location without loss of pressure.
  - Tankless water heaters require a higher gas supply than tank water heaters. Consider the following comparison:

Example – Application with a tank water heater –

Btu Rating per appliance

Tank Water Heater ------ 45,000 Btu
Gas Stove ---------- 65,000 Btu
Gas Furnace ----------115,000 Btu

Accumulated Btu's – 225,000 Btu's

Example – Application with a tankless water heater –

Btu Rating per appliance

Tankless Water Heater ----- 199,000 Btu
Gas Stove---------- 65,000 Btu
Gas Furnace ----------115,000 Btu

Accumulated Btu's – 379,000 Btu's

  - The variance in this example is 154,000 Btu's. Sizing of the gas supply system and meter capacity must be considered when increasing a structure's total Btu load.

Gas Supply Sizing Procedure – Example

The following example is known as the longest length method. A full explanation of NG and LPG pipe sizing can be found in the National Fuel Gas Code Manual

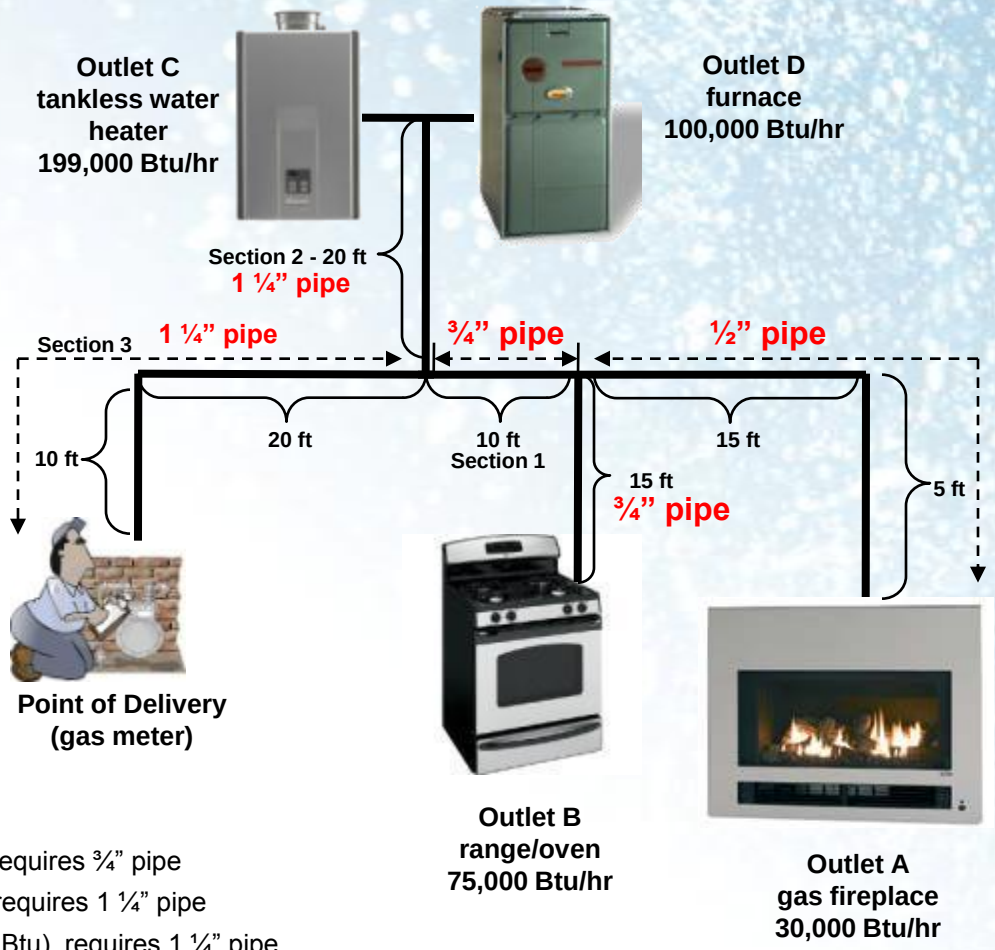
1. Determine the maximum gas (Btu) input for each appliance (see rating plate of appliance)
2. The total length of pipe from the point of delivery to the farthest appliance is 60 ft. **This is the only distance used** (longest length).
3. Refer to the appropriate table in the NFPA 54 manual. This will depend on type of pipe, type of gas, inlet pressure, pressure drop, and specific gravity. See below example:

Schedule 40 Metallic Pipe, Natural Gas, less than 2 psi inlet pressure, 0.5" w.c. pressure drop, 0.60 specific gravity

	Pipe Size (in.)				
Nominal:	½	¾	1	1 ¼	1 ½
Length (ft)	Capacity in Cubic Feet of Gas per Hour (CFH=Btu/1000)				
10	172	360	678	1390	2090
20	118	247	466	957	1430
30	95	199	376	768	1150
40	81	170	320	657	985
50	72	151	284	583	873
60	65	137	257	528	791
70	60	126	237	486	728

4. Using the row marked 60 ft in the above excerpt from table 6.2.(b):
   a) Outlet A, supplying 30 cfh (30,000 Btu), requires ½" pipe
   b) Outlet B, supplying 75 cfh (75,000 Btu), requires ¾" pipe
   c) Section 1, supplying outlets A and B, or 105 cfh (105,000 Btu), requires ¾" pipe
   d) Section 2, supplying outlets C and D, or 299 cfh (299,000 Btu), requires 1 ¼" pipe
   e) Section 3, supplying outlets A, B, C, and D, or 404 cfh (404,000 Btu), requires 1 ¼" pipe.

The below example has the following parameters:
Gas: NG Inlet pressure: less than 2 PSI



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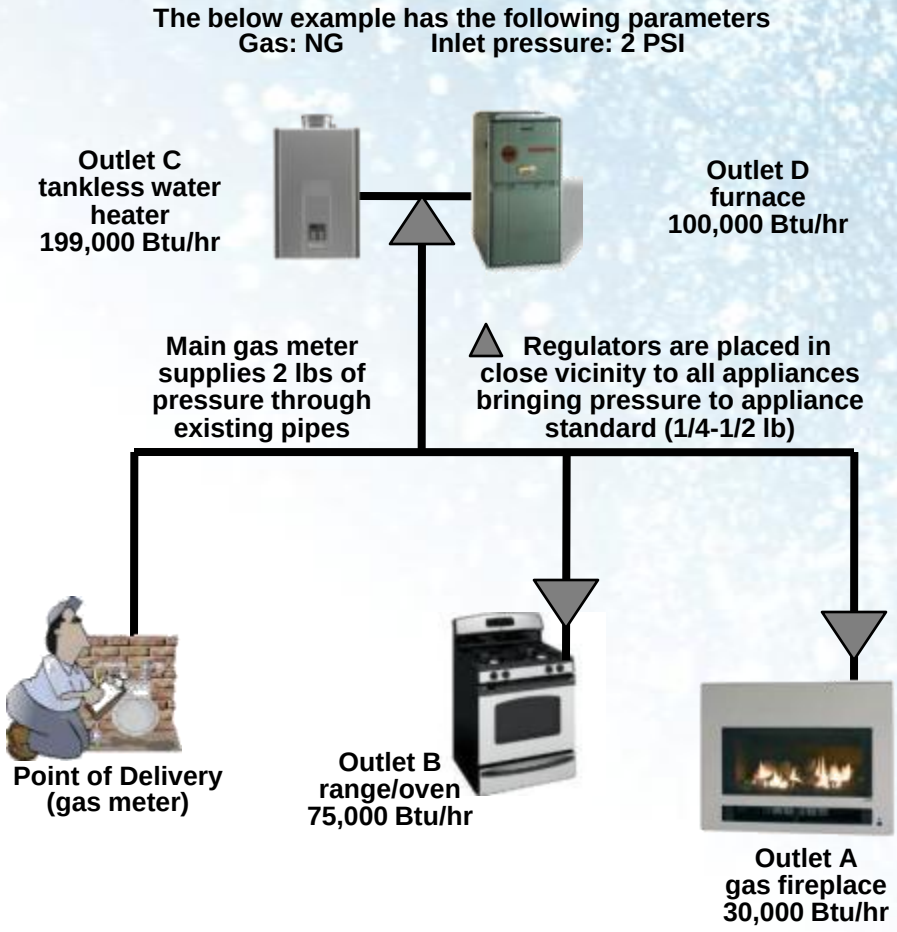
Gas System –
Two stage piping example

If resizing gas supply lines is not a feasible option, a two stage supply system may be used depending on local code guidelines. Two stage systems operate in the following manner:

- Higher pressure (usually 2 lbs or approximately 56” w.c.) is supplied for a large portion of the supply system.
- Regulators are placed close to each appliance to reduce pressure to the appliance standard of ½ lb or approximately 7-14” w.c.
- This system overcomes volume inadequacies by raising the pressure. NOTE: Never apply high pressure (such as 2 lbs) to a household appliance unless stated by the manufacturer. All Rinnai tankless water heaters require no more than ½” lb inlet pressure (14” w.c.).
- Using the previous example, if the existing gas line did not meet the NFPA standard for ½ lbs pressure, the following two stage implementation could be an alternative
- Follow NFPA 54 guideline and all code requirements when sizing two stage systems.
- Two stage systems can be used in NG or LP applications—sizing values differ by gas type
- Gas meter capacity must also be considered



Gas Supply Sizing Procedure –

Example

- Issues caused by insufficient gas supply:
  - ***Poor appliance operation***
  - ***Tankless water heater error codes***
  - ***Rumbling noises due to insufficient air/gas mixture***
  - ***Dissatisfied customer – Installer issues related to product knowledge***
  - ***Return site visit to identify gas supply issue***
  - ***Need to direct customer to contact Gas company to increase supply pressure***
  - ***Summer installations sometimes operate correctly until winter appliances are operated—thus causing delayed performance issues. Testing gas pressure while all gas appliances are operating at full capacity can prevent such issues.***
- If any symptom exists suggesting a gas supply issue may be present, a gas manometer will be needed to verify incoming pressure. Rinnai tankless water heaters only need a single port manometer. Dual port or pressure differential manometers are not needed. Various manometers are shown:

U-tube or Slack tube manometers

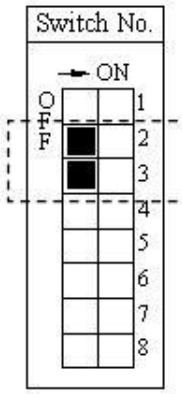
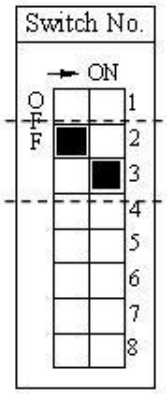
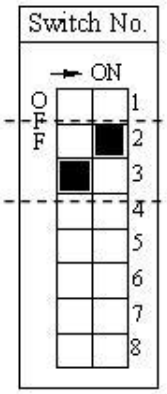
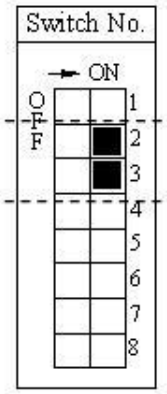
Digital manometers

Gauge manometers

High Altitude Adjustments

High Altitude Dip Switch Settings

- Proper gas volume and pressure must be supplied to the water heater at all times
- The LS series does not require any manual gas valve adjustment to compensate for high altitude. Simply set dip switches on the PCB per the specific altitude to create the appropriate burn ratio for proper operation.
  (Output is affected by altitude dip switch adjustments)

	0-2000 ft (0-610 m)	2001-5200 ft (610-1585 m)	5201-7700 ft (1585-2347 m)	7701-10200 ft (2347-3109 m)
Switch No. 2	OFF	OFF	ON	ON
Switch No. 3	OFF	ON	OFF	ON
				

Post Installation Check-List

Post Installation Check List

- ☑ Ensure the manual gas valve packaged with the water heater is installed in the gas supply line
- ☑ Ensure 120 Volts A.C. is connected to the unit, properly grounded, and that the circuit is turned on
- ☑ Verify the gas system is functioning correctly by connecting a manometer to the gas pressure test port on the unit. Operate all gas appliances in the facility at high fire. The inlet gas pressure on the unit **must not drop below** that listed on the unit's rating plate for the gas type being used.
- ☑ Make sure you have cleaned the COLD water inlet filter screen
- ☑ Inspect Hot (outlet) & Cold (inlet) water lines to ensure they have not been crossed & are leak free – *(Hot – Left) – (Cold – Center) – (Gas – Right)*
- ☑ Ensure the temperature controller is installed and functioning*. Instruct the customer how to operate the temperature controller. Instructions are supplied in the Use & Care Manual. A typical water heater set point (water temperature) is 120º F.
- ☑ Explain to the customer the importance of never blocking the intake or exhaust venting. They should never store anything around the vent exhaust.

* The V53 is not supplied with a temperature controller – default temperature 120º F, optional temperature setting 140º F

Section Review

1. **Which of the following is required by Rinnai for the electrical connection of the tankless water heater?**

   A. Local disconnect switch
   B. Dedicated circuit
   C. A properly grounded outlet or circuit
   D. All of the above

   The water heater must be properly grounded through the electrical connection for proper operation. A dedicated circuit and local disconnect switch are not required by Rinnai—these may be required by local code guidelines.

2. **What is the LS series adjustment procedure for high altitude:**

   A. Adjustment of gas manifold pressure
   B. Adjustment of vent length
   C. Adjustment of dip switches
   D. All of the above

   Compensating for high altitude only requires dip switch adjustments at the PCB

3. **If gas lines cannot carry enough volume based on the structure's total Btu load, the only alternative is resizing the gas pipe. (True/False)**

   False. *In many cases, a two stage gas pressure system will compensate for inadequate volume*.

4. **Outdoor units can be installed in unfinished crawlspaces. (True/False)**

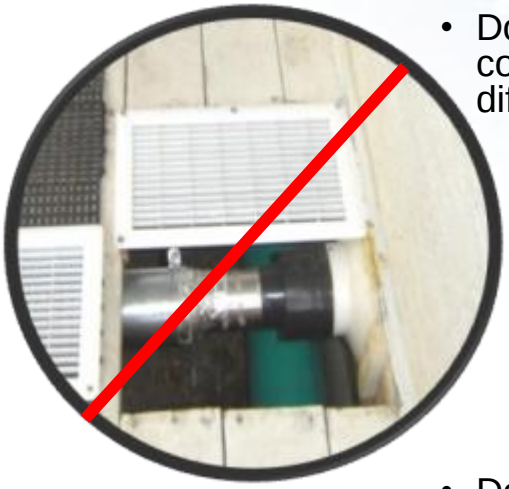
   False. *Crawlspaces (and carports) are still enclosures and require indoor units.*

VENTING REQUIREMENTS

! WARNING

Improper installation of vent system and components, or failure to follow all installation instructions, can result in property damage or serious injury

Intake / Exhaust Guidelines



- Do not combine vent components from different manufacturers

- The vent system must vent directly to the outside of the building with proper termination clearances

- Do not connect the venting system with an existing vent or chimney

- Do not use Class-B vent

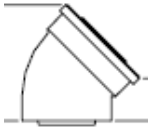
- Vent diameter must not be reduced
- Do not common vent with the vent pipe of any other water heater or appliance

Indoor - Vent Length Calculator

Elbow Length Calculator

= 6 Feet

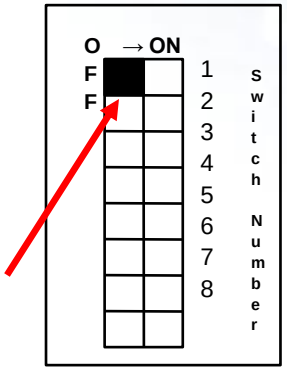
Each 90° bend is equivalent to 6 feet of vent pipe



= 3 Feet

Each 45° bend is equivalent to 3 feet of vent pipe

- Total equivalency cannot exceed 41 feet
- If the equivalency is greater than 21 feet, move dip switch #1 (bank of eight) to OFF
  (this switch is shipped in the ON position)



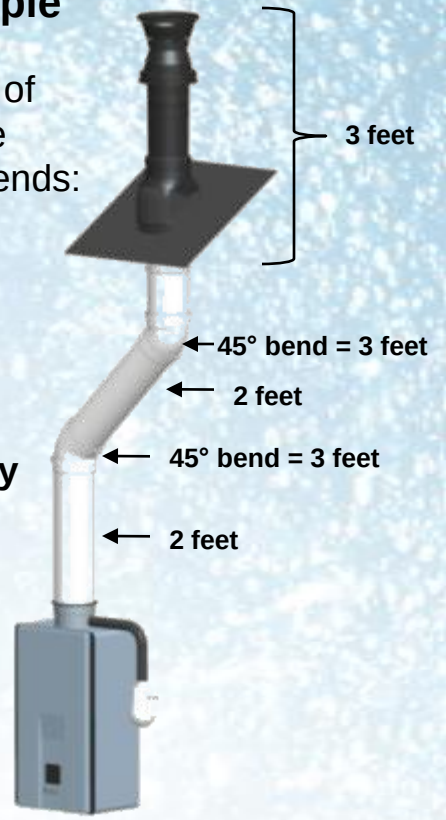
Vent Length Example

Add the total length of all vent pipe and the equivalency of all bends:

3' (termination)
+3' (bend)
+2' (extension)
+3' (bend)
+2' (extension)

13 foot equivalency

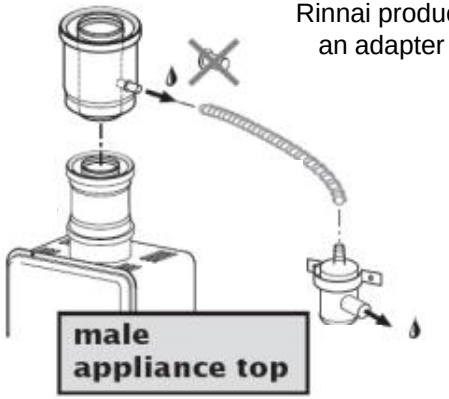
In this example, dip switch #1 would remain in the ON position



- Comply with all vent guidelines – refer to vent manufacturer and installation instructions.
- The R94LSi maximum water flow capacity will be reduced by roughly 10% when dip switch no. 1 is OFF.
- These images depict concentric venting. R98 models do not use concentric venting but use the same equivalency guidelines.

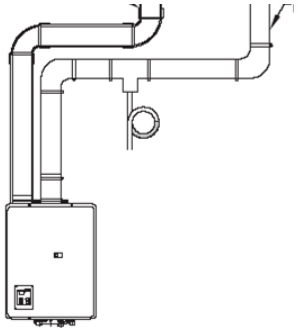
Vent Condensate

- Condensation occurs when the water created in the combustion process cools below the dew point. As this water vapor condenses, it combines with other combustion by-products to form an acid solution. The resultant acid will collect and eventually destroy the joints and seams of any vent system not designed and or installed to properly drain the condensate solution.
- Condensate formation can occur in high efficiency direct vent appliances.
  - Space provisions must be made to properly drain and dispose of the condensate.
  - The condensate drain trap must contain a minimum of 3” of water.
  - Dispose of condensate per local codes.



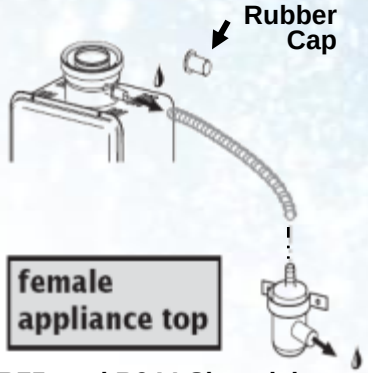
Older concentric models

Rinnai products with a male appliance top require an adapter connect to a condensate collector.



R98 LSi models

Rinnai products with a female appliance top have an integrated condensate collector. Removal of the rubber cap is required to connect the collector.



R50, R75, and R94 LSi models

- Short horizontal vent runs (without a condensate drain) must slope to the vent termination 1/4” per foot
- Vertical terminations or long horizontal terminations must incorporate a condensate drain and trap as close as possible to the appliance.

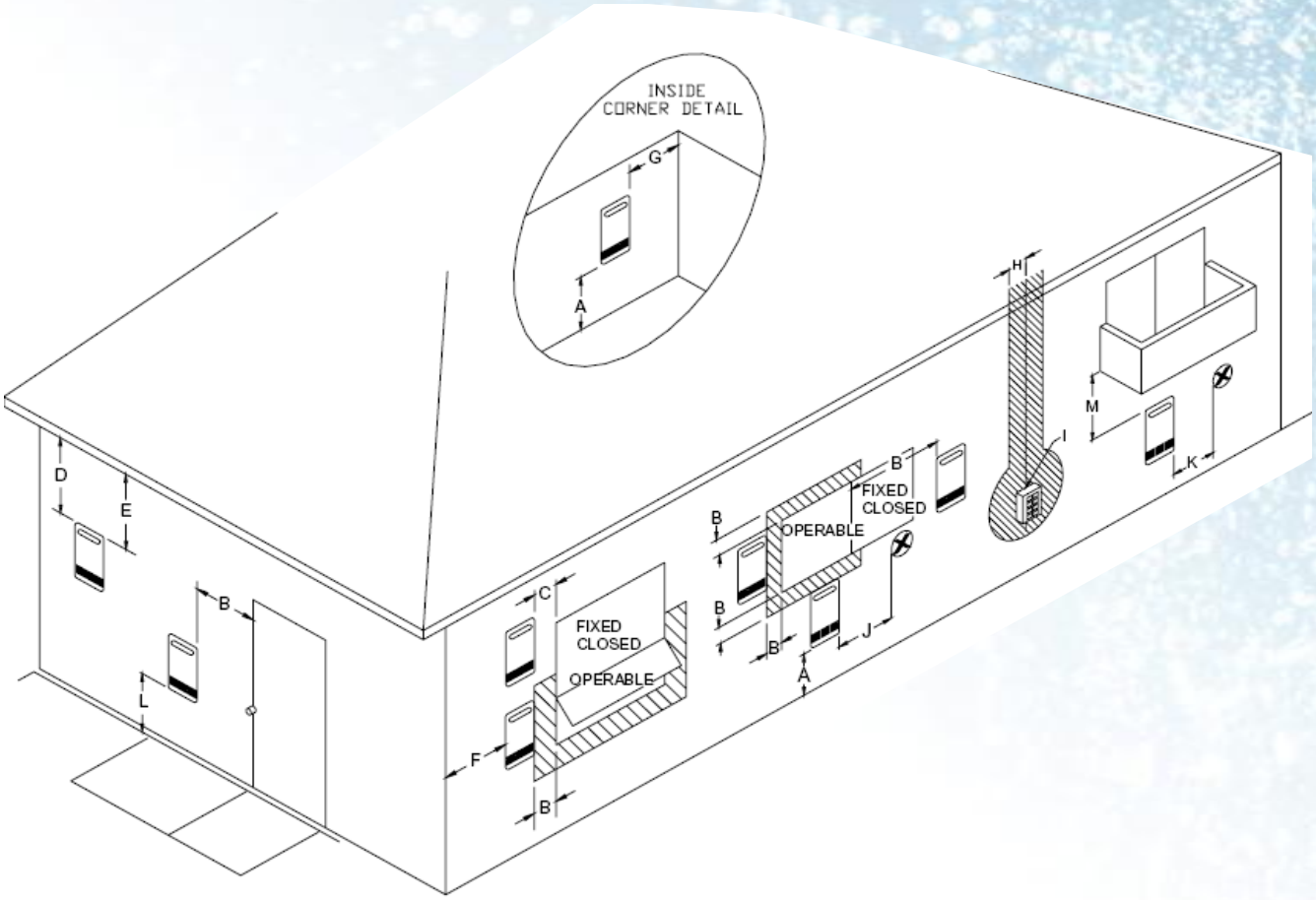
LSi Vent Clearances – ANSI Standards
(for all Rinnai Water Heaters)

Rinnai

AIR SUPPLY INLET

VENT TERMINAL

AREA WHERE TERMINAL IS NOT PERMITTTED



See Chart on the following page for the ANSI recommended clearance of each corresponding letter

LS Vent Clearances (for all Rinnai Water Heaters)

View Structure on previous page

Ref	Description	U.S. Specifications	Canadian Specifications
A	Clearance above grade, veranda, porch, deck or balcony	12 inches (30 cm)	12” (30 cm)
B	Clearance to window or door that maybe opened	12 inches (30 cm)	36” (91 cm)
C	Clearance to permanently closed window	*	*
D	Vertical clearance to ventilated soffit, located above the terminal within a horizontal distance of 2 feet (61 cm) from the center line of the terminal	*	*
E	Clearance to unvented soffit	*	*
F	Clearance to outside corner	*	*
G	Clearance to inside corner	*	*
H	Clearance to side of center line extended above meter / regulator assembly	*	3 feet (91 cm) within a height 15 feet (5 m) above the meter / regulator assembly
I	Clearance to service regulator vent outlet	*	36 inches (91 cm)
J	Clearance to non-mechanical air supply inlet to building or the combustion air inlet to any other appliance	12 inches (30 cm)	36 inches (91 cm)
K	Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (2 m)
L	Clearance above paved sidewalk or paved driveway located on the public property	*	7 feet (2.25 m) ①
M	Clearance under veranda, porch, deck, or balcony	*	12 inches (30 cm) ②

ANSI Z223.1

① A vent shall not terminate directly above a sidewalk or paved driveway that is located between two single family dwellings and serves both dwellings.

② Permitted only if veranda, porch, deck or balcony is fully open on a minimum of two sides beneath the floor.

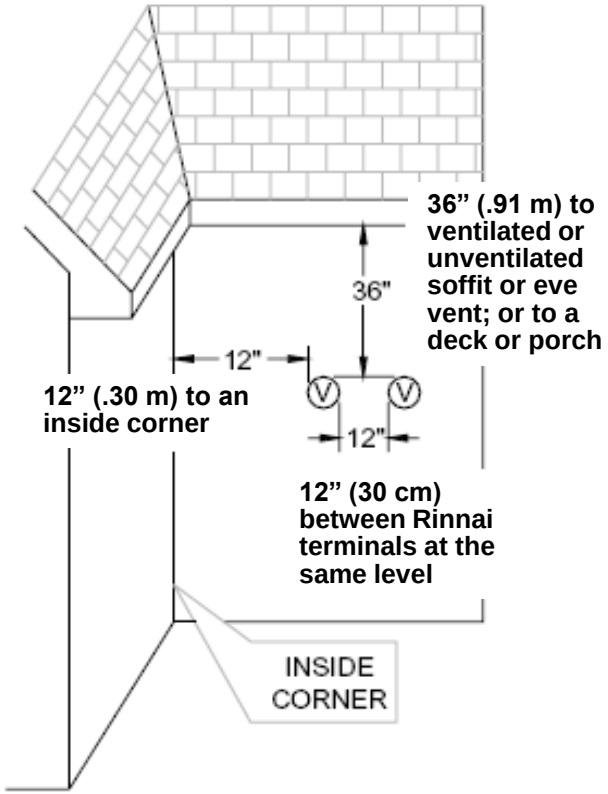
***** For clearances not specified in ANSI Z223. 1/NFPA 54 or CSAB149.1, clearances are in accordance with local installation codes and the requirements of the gas supplier.

Rinnai Vent Termination Requirements

(for all Rinnai Water Heaters)

Rinnai

Ⓥ Vent terminal represents concentric vent terminal or R98 LS series exhaust vent only or external exhaust where applicable

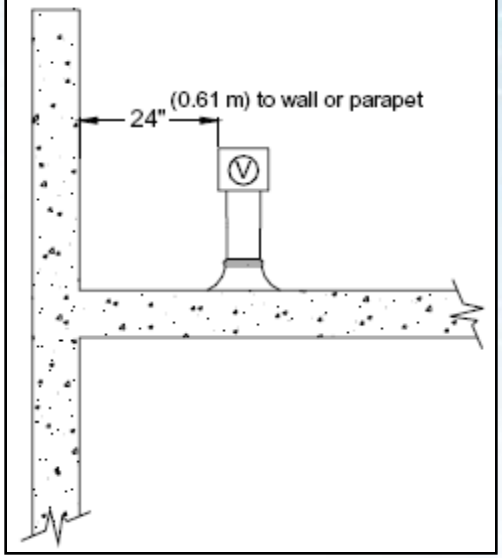


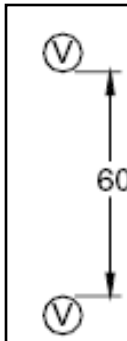
36" (.91 m) to ventilated or unventilated soffit or eve vent; or to a deck or porch

12" (.30 m) to an inside corner

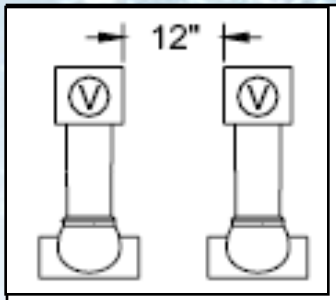
12" (30 cm) between Rinnai terminals at the same level

The above clearances also apply to LSe external models.



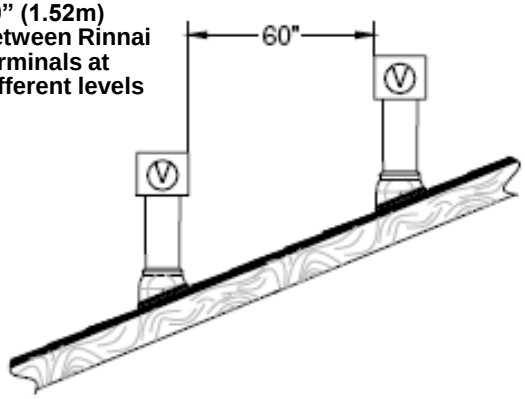


60" (1.52m) vertically between Rinnai terminals (Also applies to LSe external models)



12" (30 cm) between Rinnai terminals at the same level

60" (1.52m) between Rinnai terminals at different levels



- Avoid terminations near a dryer vent
- Avoid terminations near commercial cooking exhaust
- Comply with local and state codes as required

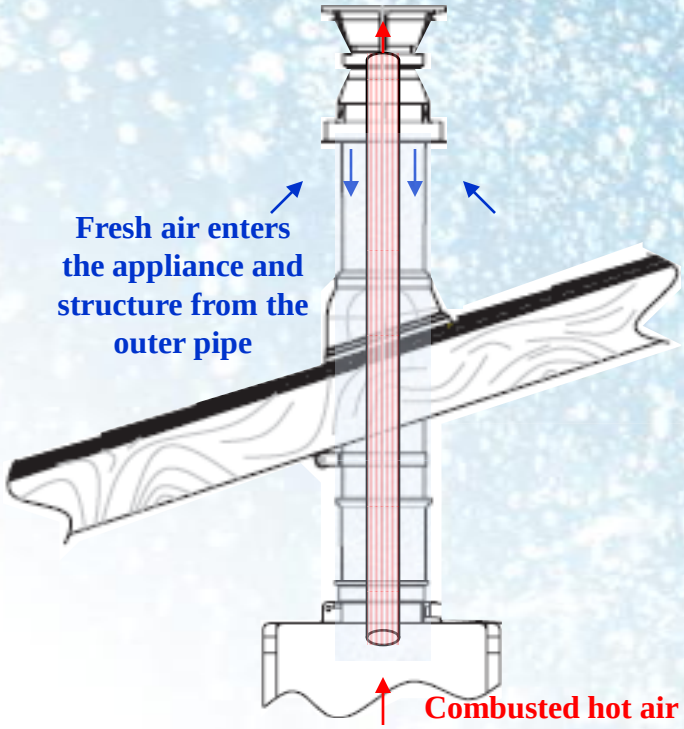
Intake / Exhaust Guidelines

For R50, R75, and R94 LSi models only

- Rinnai LSi series models are direct vent water heaters and therefore are certified and listed with the vent system. Only vent components that are certified and listed with the water heater model should be used. Refer to the following table:

Listed and Tested Vent Products for the R50LSi, R75LSi, and R94LSi	
Manufacturer	Product
Rinnai/Ubbink	Rolux Vent System (available thru Rinnai-see Appendix C P. 109)
Heat-Fab	Saf-T Vent SC system
Metal-Fab	Corr/Guard Vent/Air Intake System

- R50, R75, and R94 LSi models use a concentric venting system which allows zero clearance from combustibles.
  - These models are equipped with a female vent connection at the top of the water heater. Therefore, an appliance adaptor is NOT needed.
  - These models come equipped with an integrated condensation collector in the vent.

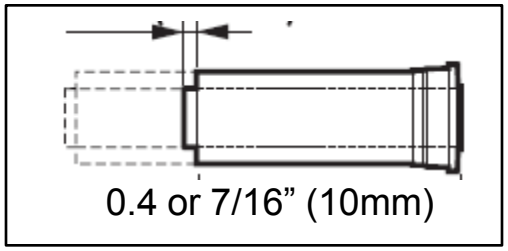

Fresh air enters the appliance and structure from the outer pipe
Combusted hot air exits the appliance and structure from the center pipe

This is a balanced flue system. The incoming air keeps the pipe cool, allowing zero clearance for the venting system.

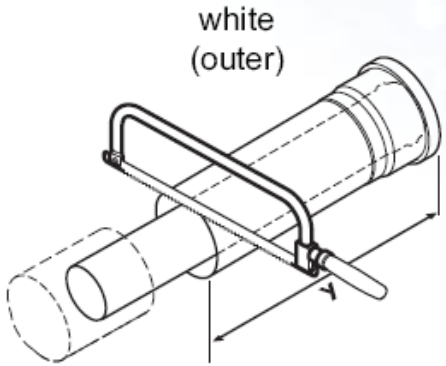
Cutting Ubbink Vent Pipe

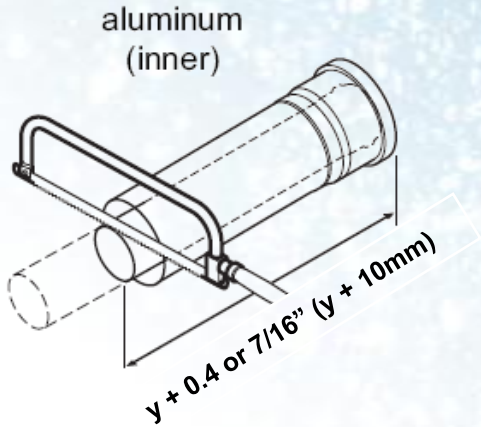
Improper installation of vent system and components, or failure to follow all installation instructions, can result in property damage or serious injury.

- Certain applications require the vent pipe to be shortened to fit the application
- Shortening of Vent Pipe Extensions –
  - The aluminum inside pipe should always extend 0.4 or 7/16” (10 mm) beyond the white outside of the male end of the vent extension.
  - Always cut the male end of the vent pipe extension. Do not attempt to cut the female end.

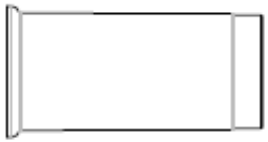


Overall length = length of the outer pipe + 0.4 or 7/16”





- Ubbink also offers a telescopic vent extension that requires no cutting. This can reduce install time and prevent possible vent sealing issues.



Telescopic vent effective length is 2.2” – 12”

Intake / Exhaust Guidelines

Ubbink vertical terminations are preset to the portion that is to be exposed.

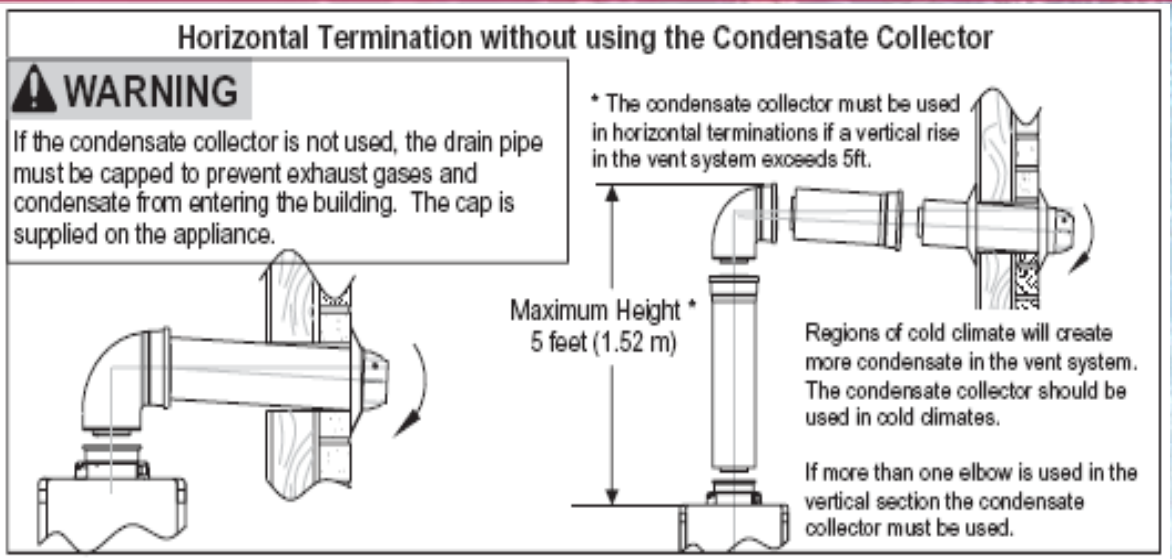
- Only the black portion of the vertical termination should be exposed to the exterior.
- No Ubbink pipe joints should be exposed to the outside

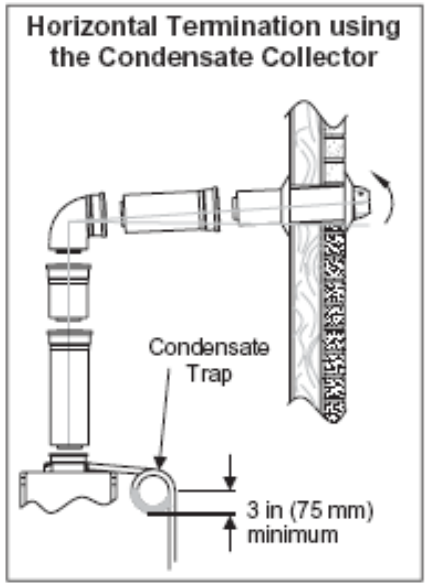
- Ubbink offers a paintable “snorkel” kit that will in many cases allow for a low structure termination while protecting all joints.

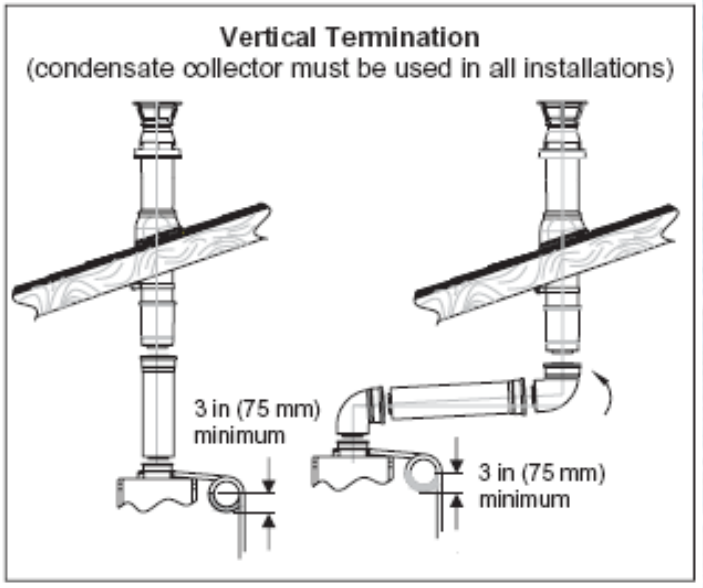
R50LSi, R75LSi and R94LSi Vent Termination

The diagrams illustrate the correct way to address condensation with Rinnai concentric vented water heaters (all R50, R75, R94LSi models)

- The integrated condensate collector MUST BE used on all vertical vent terminations and on any horizontal vent termination where the vertical run exceeds 5 feet or two or more elbows exist.
- If the condensate collector is used in a horizontal vent termination, the exhaust venting MUST BE sloped 1/4" per foot towards the water heater.
- If no condensate collector is used in a horizontal vent termination the exhaust venting MUST BE sloped 1/4" per foot towards the exhaust terminal.
- The condensation trap MUST contain at least 3” of water


Horizontal Termination without using the Condensate Collector
WARNING
If the condensate collector is not used, the drain pipe must be capped to prevent exhaust gases and condensate from entering the building. The cap is supplied on the appliance.
* The condensate collector must be used in horizontal terminations if a vertical rise in the vent system exceeds 5ft.
Maximum Height * 5 feet (1.52 m)
Regions of cold climate will create more condensate in the vent system. The condensate collector should be used in cold climates.
If more than one elbow is used in the vertical section the condensate collector must be used.





Intake / Exhaust Guidelines

For R98LSi models only

- Refer to the vent pipe manufacturer's instructions for component assembly instructions.
- The R98LSi model is a direct vent water heater and therefore is certified and listed with the vent system. Only vent components that are certified and listed with the R98LSi should be used. Refer to the following table:

Listed and Tested Vent Products for the R98LSi	
Manufacturer	**Product**
ProTech Systems	FasNSeal (available thru Rinnai—see Appendix C, pg 109)
Heat-Fab	Saf-T Vent
Z-Flex	Z-Vent
Metal-Fab	Corr/Guard

- R98LSi models separate venting for exhaust and intake
  - Concentric terminations are available for the R98LSi allowing a single exit point through the structure.
  - The following clearances from combustibles must be maintained from the exhaust venting:

CLEARANCE TO COMBUSTIBLES (For all R98LSi)	Vent Size	Enclosed (on 4 sides)		Unenclosed (3 sides or less)	
		Horizontal	Vertical	Horizontal	Vertical
	4”	4”	4”	1”	1”

  - The air intake system consists of a field supplied 4” diameter stainless steel, Schedule 40 PVC, ABS, or CPVC, pipe.
  - A maximum 6 feet of semi-rigid flexible aluminum ducting can also be used. Foil wrapped dryer vent and cell core products are not authorized.
  - An appliance adaptor must be the first venting component connected to the R98LSi

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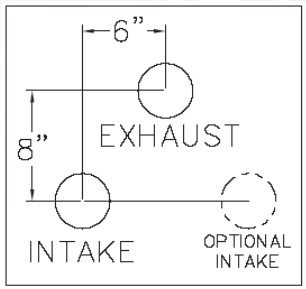
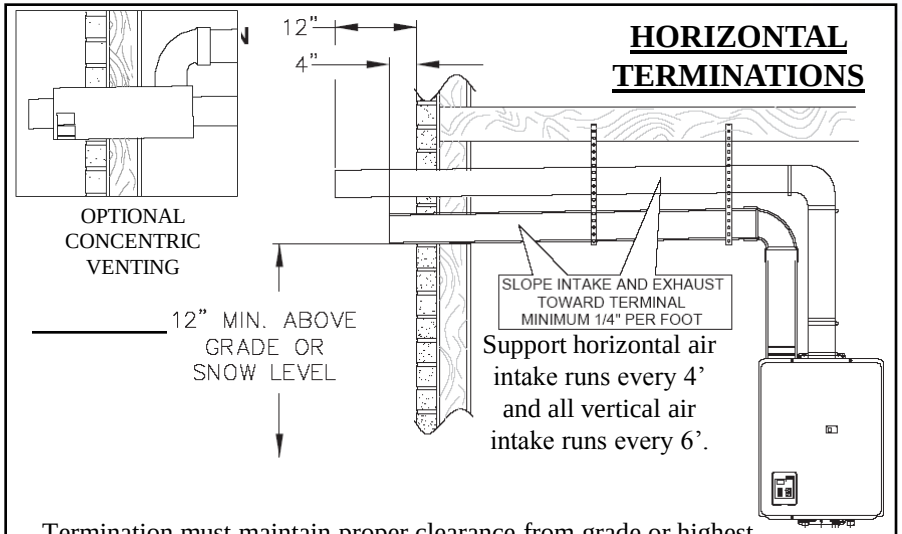
R98LSi Vent Termination

HORIZONTAL TERMINATIONS

Correct distances between exhaust and intake must be maintained for proper performance.



EXHAUST/INTAKE RELATIONSHIP

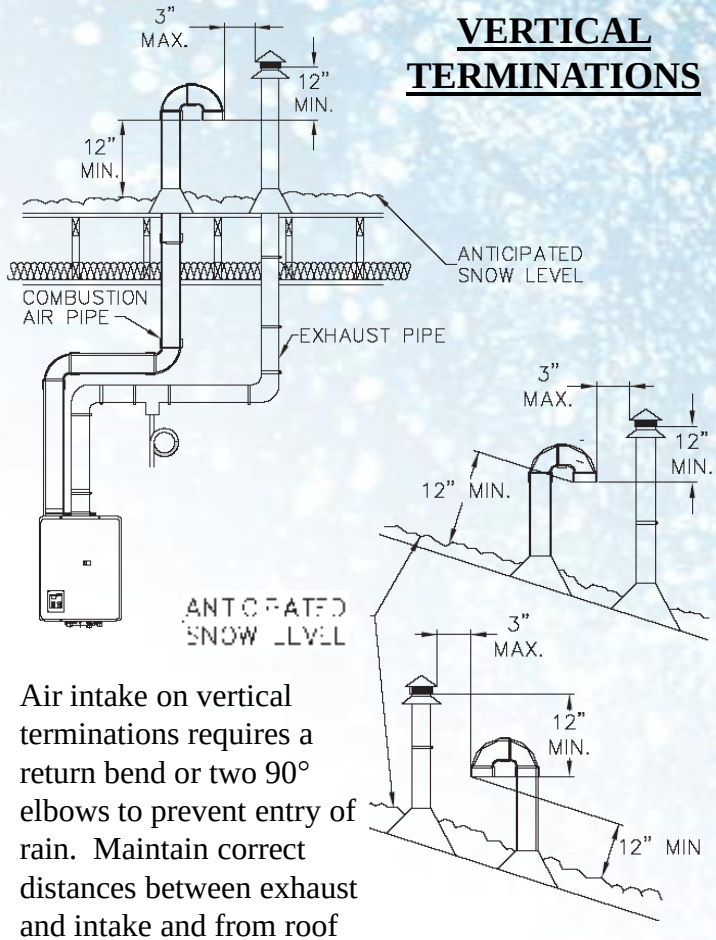

12"
4"
OPTIONAL CONCENTRIC VENTING
12" MIN. ABOVE GRADE OR SNOW LEVEL
SLOPE INTAKE AND EXHAUST TOWARD TERMINAL MINIMUM 1/4" PER FOOT

HORIZONTAL TERMINATIONS

Support horizontal air intake runs every 4' and all vertical air intake runs every 6'.

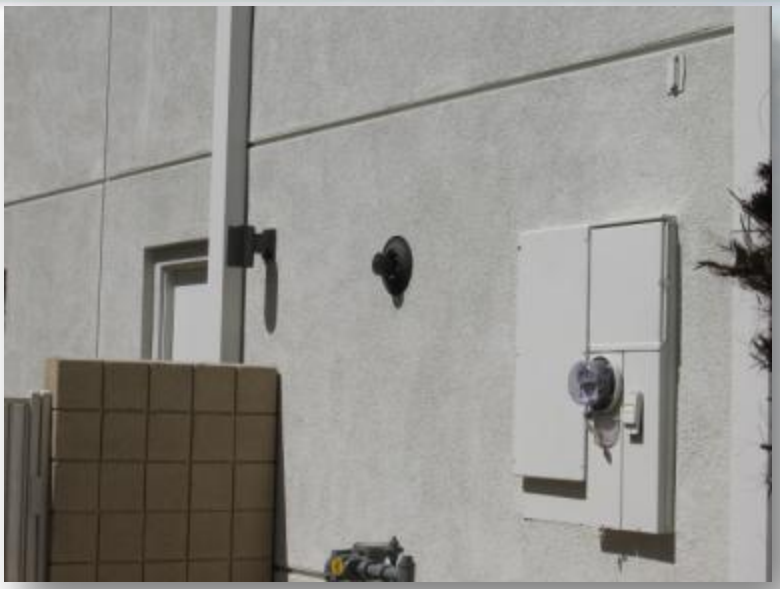
Termination must maintain proper clearance from grade or highest anticipated snow level and extend past wall the correct distance.

VERTICAL TERMINATIONS



Air intake on vertical terminations requires a return bend or two 90° elbows to prevent entry of rain. Maintain correct distances between exhaust and intake and from roof line or snow level.

Proper Venting Installations



Section Review

1. **Double-wall B-vent is approved for Rinnai indoor tankless water heaters. (True/False)**

   False. *No type of B-vent is approved for any current Rinnai tankless water heater*

2. **What is the total allowable vent equivalency of Rinnai indoor tankless water heaters?**

   A. 21 feet B. 6 feet

   B. 41 feet D. 3 feet

   Total equivalency including all 90° and 45° bends is 41 feet

3. **R98 LSi models have zero clearance from combustibles for the entire vent length. (True/False)**

   False. *The exhaust portion of the R98 LSi must have a 4" clearance if enclosed on four sides or a 1" clearance if enclosed on 3 or fewer sides*

4. **Which of the following vent installations must use the integrated condensate collector?**

   A. Any vertically terminated vent system

   B. Any horizontally terminated vent system

   C. Horizontal vent systems with more than 5' of vertical rise

   D. Horizontal vent systems with two or more bends

   E. A, C and D

   Employing the condensate collector in these installations is very important for proper operation and warranty adherence

TEMPERATURE CONTROLLERS

LSi Temperature Controllers

Five Temperature Controllers

MC-91
MCC-91*
***for commercial / hydronic use only**

MC-502RC

MC-100

BC-100

All Rinnai LS models will accept up to four temperature controllers installed in parallel in any combination (exception: only one MC-100 per unit and/or one BC-100 per unit)

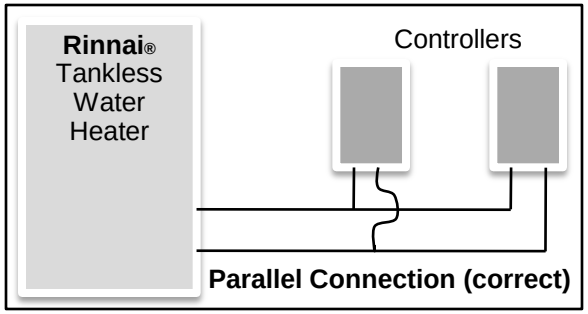
LSi Temperature Controllers

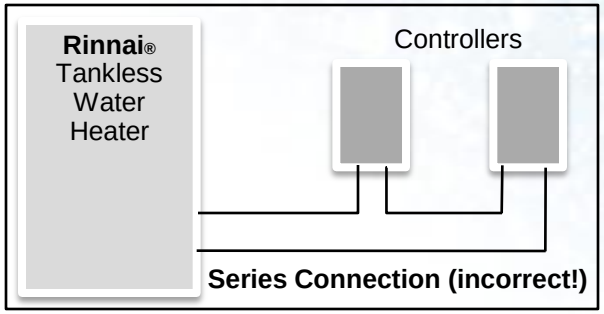
Temperature Controller Installation Requirements

Temperature controller connection

*The connection for temperature controllers for the R63LSe and V53e are located on the bottom of the cabinet

- Refer to owner's / installation manual of each model for specific installation instructions
- *Controller wires are to be connected to the unit where labeled "Terminals for Controls." Wires are not polarity sensitive.
- Indoor LS models come with a temperature controller integrated into the front cover and its wiring already connected
- Outdoor LS units come with an independent temperature controller to be installed remotely.
- Controllers operate on 12 VDC and should never be connected to supply voltage (120 VAC)
- Controllers can be located anywhere in the structure protected from heat, direct sunlight, water, and small children
- Standard thermostat wire can be used to connect the controller to the water heater if needed
- When connecting multiple controllers, they must be wired in parallel:





Temperature Controller-

Features

The below table indicates current model controller compatibility and temperature ranges.

	WATER HEATER Model #	Shipped with MC-91 to be installed remote from unit	Shipped with MC-91 factory installed in front cover of unit**	Temperature with no remote	Temperature range when installed with MC-91, MC-100, BC-100, or MC-502-RC	Temperature range when installed with MCC-91*
Indoor	R50LSi, R75LSi		✓	Default - 120° F 140° F can be achieved by adjusting dip switches (see install manual)	98°-140° F	98°-160° F
Indoor	R94LSi, R98LSi		✓			98°-185° F
Outdoor	R63LSe, R75LSe	✓				98°-160° F
Outdoor	R94LSe, R98LSe	✓				98°-185° F
Outdoor	V53e	V53e models are not shipped with a temperature controller. They do have an error code display and can accept controllers				Not Applicable V53e models are not approved for commercial use.

***commercial applications only**

- Controllers can be installed virtually anywhere within a structure (i.e. kitchen, laundry, master and/or secondary bath)
- Up to four temperature controllers can be installed for each water heater. Multiple controllers must be wired in parallel.
- LS Series units require the installation of one MCC-91 controller to achieve commercial level temperatures. All other controllers installed on the same water heater will then be able to achieve commercial level temperatures as well.
- An MC-91 controller can be installed where commercial application temperatures do not exceed 140°F
- The MCC-91 controller can be installed for additional commercial applications that require temperatures up to 185°F such as commercial kitchens and hydronic applications
- Diagnostic testing includes the ability to display unit's flow rate, output water temperature, and previous diagnostic codes

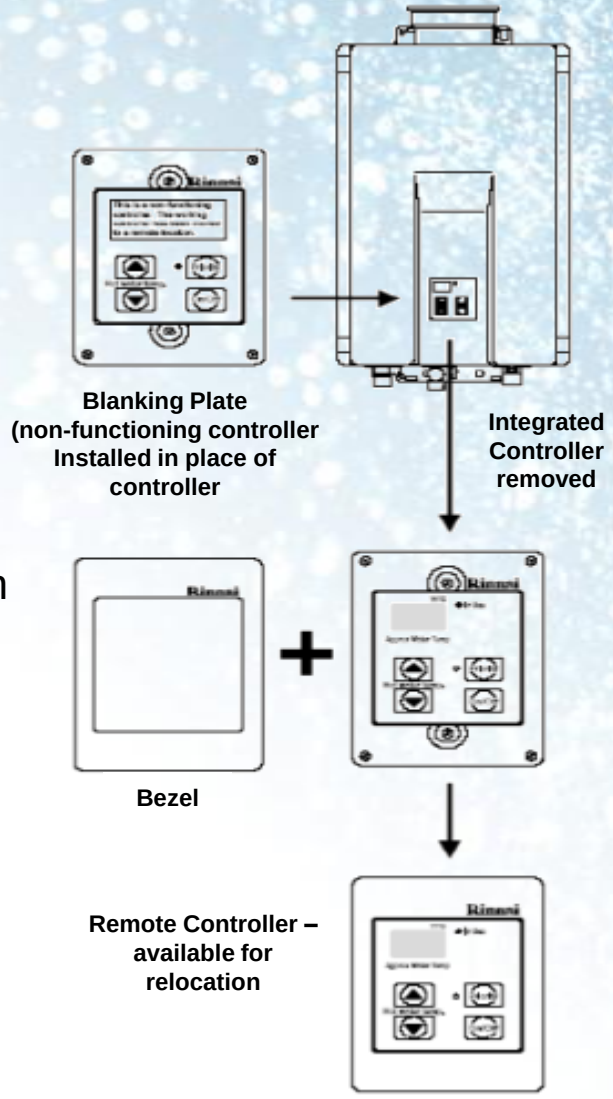
Temperature Controller -
MC-91 Relocation Kit

If an LSi water heater is placed in an inaccessible location, like an attic or crawl space, the installer could use this kit to remove the MC-91 from the front panel and relocate it to a remote location.

- The "Blanking Plate" fills the hole left by removing the working Blanking Plate Bezel controller.

- The working MC-91 controller assembly lacks an outer trim piece (bezel) and so requires that the bezel that comes with the kit be snapped on to make it look like a complete unit.

- Accessory part number: MC-91-1US-S-RK



Temperature Controller –
Adjustments and Troubleshooting

MC-91-1US

Standard with all new units

For other remote specifications, see owner's manual of specific model.

To change the display from °F to °C or °C to °F:

With the controller off press and hold On/Off for approximately 5 seconds.

To mute the audible beep:

Press and hold the ▲ and ▼ until an audible beep is heard (approximately 5 seconds).

All temperature controllers also provide the following diagnostic capabilities:

To display water flow (GPM) through water heater:

Press ▲, hold for 2 seconds, and simultaneously press On/Off

To display outlet water temperature:

Press ▼, hold for 2 seconds, and simultaneously press On/Off

To display previous maintenance codes:

Press On/Off, hold for 2 seconds, and simultaneously press ▲

NOTE: The MC-100 also has an extended diagnostic menu to aid in servicing. Contact Rinnai for more details.

MC-91/MCC-91 Temperature Controls

Rinnai

TEMPERATURE INDICATION

Indicates the selected water temperature. Diagnostic Codes flash if operator intervention is required.

THERMOSTAT

Increases or decreases the desired water temperature

MODEL NUMBER

IN USE INDICATOR

Indicates that the unit is in operation

PRIORITY BUTTON & INDICATOR

When multiple controllers are installed, the priority button allows each to individually set temperature output of the water heater. The priority indicator reports which controller has control.

ON/OFF BUTTON

MC-100 Temperature Control

IN USE INDICATOR

Flame indicates unit is in operation

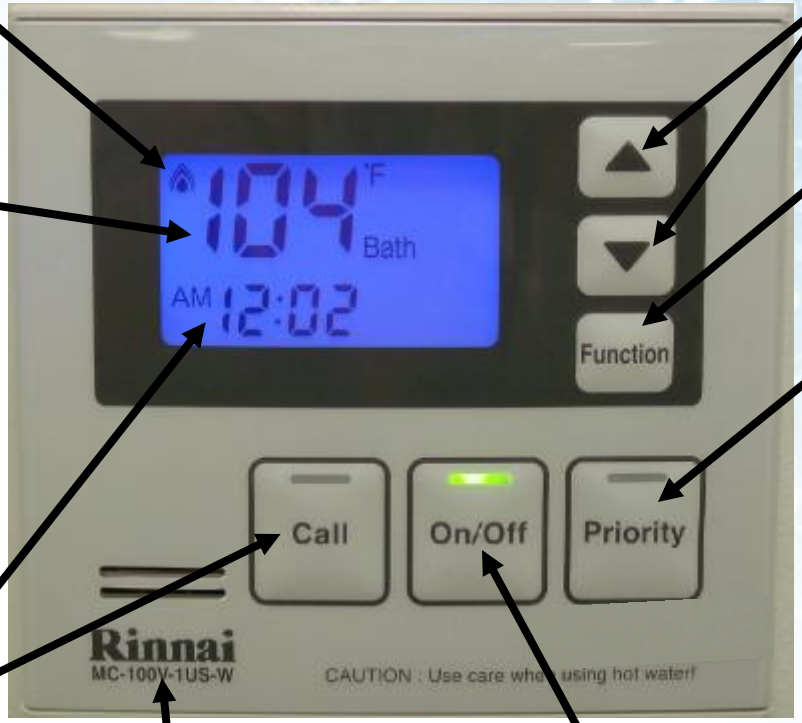
TEMPERATURE INDICATOR

Indicates the selected water temperature. Diagnostic Codes flash if operator intervention is required. "Bath" indicates bath fill function on BC-100 is currently in use.

TIME DISPLAY

CALL BUTTON

Pages (by beeping) all other temperature controllers installed on the same water heater



MODEL NUMBER

ON/OFF BUTTON

THERMOSTAT

Increases or decreases the desired water temperature

FUNCTION

Sets time and sound volume

PRIORITY BUTTON AND INDICATOR*

When multiple controllers are installed, the priority button allows each controller to individually set temperature output of the water heater. The priority indicator reports which controller has control.

***Only one MC-100 can be installed for each water heater.**

The MC-100 also has an extended diagnostic menu to aid in servicing. Contact Rinnai technical support for additional information.

BC-100 Temperature Control

Rinnai

PRIORITY BUTTON AND INDICATOR

When multiple controllers are installed, the priority button allows each controller to individually set temperature output of the water heater. The priority indicator reports which controller has control.

IN USE INDICATOR

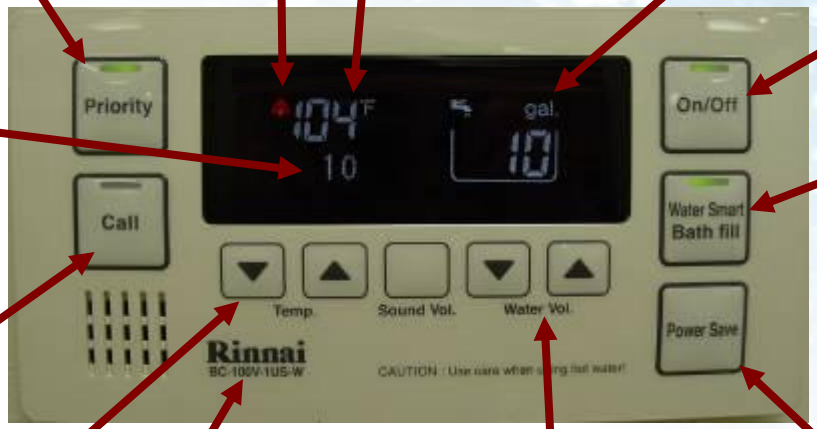
Flame indicates unit is in operation

TEMPERATURE INDICATOR

Indicates the selected water temperature. Diagnostic codes flash when operator intervention is required.

WATER VOLUME

Indicates volume of water selected for bath fill function



ON/OFF BUTTON

BATH FILL DISPLAY*

Indicates remaining fill amount when Bath Fill is selected. When not selected and an MC-100 is also installed, the time will be displayed.

BATH FILL BUTTON*

Pressing bath fill button allows you to program in a selected amount of water to fill tub. Once that amount of water is delivered, water heater will shut off.

CALL BUTTON

Pages (by beeping) all other temperature controller installed on the same water heater

MODEL NUMBER

WATER VOLUME BUTTONS

Allows you to adjust bath fill volume in gallons

POWER SAVER

Turns display off after a predetermined time to save energy

THERMOSTAT

Increases or decreases the desired water temperature

*Bath fill feature allows temperature adjustments from 98º F to 120º F. The BC-100 monitors flow through one water heater. **DO NOT use this feature in applications with two or more water heaters. Do not use with single handled fixtures. Use only hot water when using the BC-100 controller.**

MC-502RC Temperature Control

Communication Strength

Indicates strength of signal

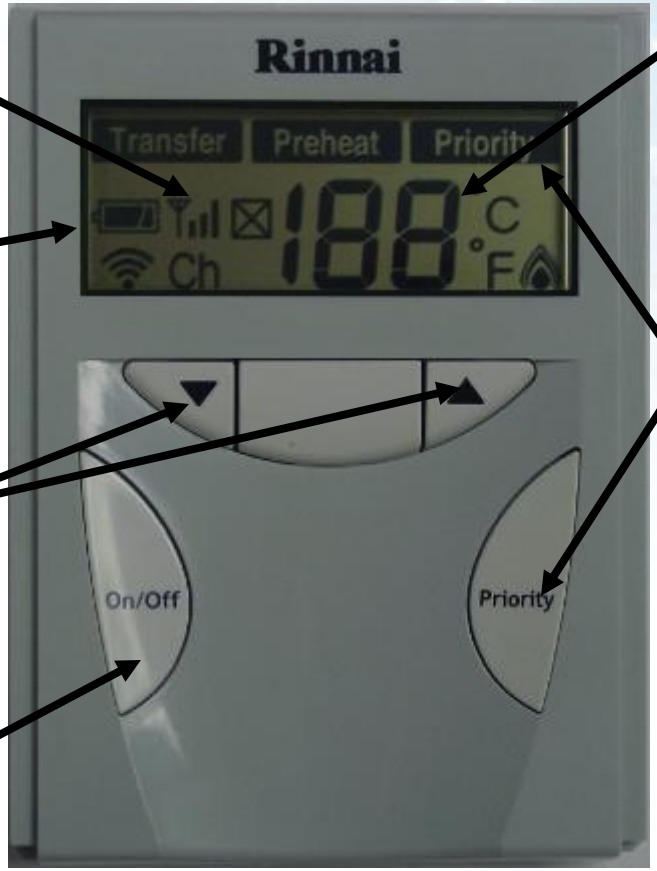
Battery Life

Controller requires 4 AA batteries

Thermostat

Increases or decreases the desired water temperature

On/Off Button



Temperature Indicator

Indicates the selected water temperature. Diagnostic codes flash when operator Intervention is required.

Priority indicator and button

When multiple controllers are installed, the priority button allows each controller to individually set temperature output of the water heater. The priority indicator reports which controller has control.

Transceiver

The MC-502RC kit contains: Wireless controller (1) Transceiver (1)

Individual Component part numbers:
Wireless Controller – MC-502RC-1-US-S
Transceiver – MC-502RC-1-US-M

- One transceiver works with up to four wireless controllers
- Error codes flash on controller. Diagnostic information available at the transceiver.
- Transceiver must be installed inside the home or structure and hardwired to the water heater terminals. Transceiver is designed for use in wood construction only. Do not install transceiver inside a recess box
- The transceiver also has the ability to limit the maximum temperature of any wireless controller interfaced with it. This can be very helpful in special applications such as convalescent homes, daycares, etc.

Section Review

1. **Multiple temperature controllers must be wired in:**

   A. Series B. Parallel

   Parallel. Wiring in series will not allow the proper voltage to each controller.

2. **An MCC-91 temperature controller must be purchased for any commercial application. (True/False)**

   ***False**. If a commercial application does not exceed 140° an MCC-91 is not needed. The commercial warranty will still apply.*

3. **Which of the following are diagnostic features available from MC-91/MCC 91 temperature controllers?**

   A. GPM Flow
   B. Report of previous error codes
   C. Outgoing water temperature
   D. A, B and C

   The above diagnostic tests can be very helpful to ensure proper operation

4. **Which of the following are true statements?**

   A. All indoor Rinnai tankless LS series water heaters come with an MC-91 controller mounted in the front cover

   B. All outdoor Rinnai tankless water heaters come with an MC-91 to be installed remotely

   C. All Rinnai tankless water heaters will operate without a temperature controller at a default temperature of 120° F

   D. All Rinnai tankless water heaters will accept a maximum of four temperature controllers

   E. A, C, and D

   All outdoor units EXCEPT the V53e come with an MC-91. This can be purchased and connected to the V53e at the point of installation.

MANUFACTURER ACCESSORIES

Accessory Compatibility Parts List

LS Series Accessory Compatibility			
Model	**Multiple System Compatibility**	**Pipe Cover Boxes**	**Recess Boxes**
Outdoor Products			
V53e	PVA – Pressure Activated Valve	PC-20-W	RGB-20U
R63LSe		PCD01-SM2	
R75LSe	EZConnect™ (for 2 units only) or MSA 2 (for 2-5 units)	PCD03-SM2	RGB-25U or RGB-25U-MSAL MSAL=Moisture Seal Aluminum
R94LSe			
R98LSe or R98LSe ASME		Coming Soon	RGB-32
Indoor Products			Not Applicable
R50LSi	EZConnect™ (for 2 units only) or MSA 2 (for 2-5 units)	PCD03-SM	
R75LSi			
R94LSi			
R98LSi or R98LSi ASME		Coming Soon	

RECESS BOXES

- Recess boxes allow outdoor units to be installed recessed into an exterior wall.
- A universal recess box for each model size is offered.
- A moisture seal-aluminum recess box is offered for R75/R94LSe models. This is a flanged recess box designed for new builds to allow a water tight seal within the enclosure.
- Due to its width, the R98LSe recess boxes must be installed below a load bearing header. See installation instructions for details.
- A retrofit kit is available to allow the installation of an LS water heater in an older RGB25 recess box.

PIPE COVER BOXES

- Pipe Cover boxes mount underneath indoor or outdoor units to cover visible pipes and valves increasing security and allowing for possible insulation of pipes.
- Pipe cover boxes connect to the bottom of indoor or outdoor water heaters providing an aesthetically pleasing cover for incoming piping and electrical connections
- Pipe cover boxes also provide additional security and allow insulation of incoming plumbing inside the box
- Ensure the correct model box is ordered for each model water heater (color and design should be considered)
- Pipe cover boxes for the R98LS series will be available in late 2008

Multiple Unit Operation

Use an EZConnect™ cable or MSA controller when banking multiple units on the same manifold system in residential or commercial applications.

- This technology sequences or rotates between units to prevent one unit from being overworked.
- In addition, it ensures each unit is firing at the same rate during operation and electronically balances the flow rate through each unit, eliminating the need for balancing valves.
- View the table below for the most efficient method depending on model and number of units per system.

MODEL / NO. OF UNITS	R98LS, R94LS, R75LS, R50LS	R63LS, V53e (not compatible with MSA/EZConnect™ controls)
2	1-EZConnect™ cable (preferred) or 1-MSA-2M	*PVA Valve Kit(s) See PVA Installation Instructions for quantity and settings
3	1-MSA-2M & 1 MSA-2S	
4	1-MSA-2M & 2 MSA-2S	
5	1-MSA-2M & 3 MSA-2S	
Over 5	*MSA controllers and PVA Kit(s)	

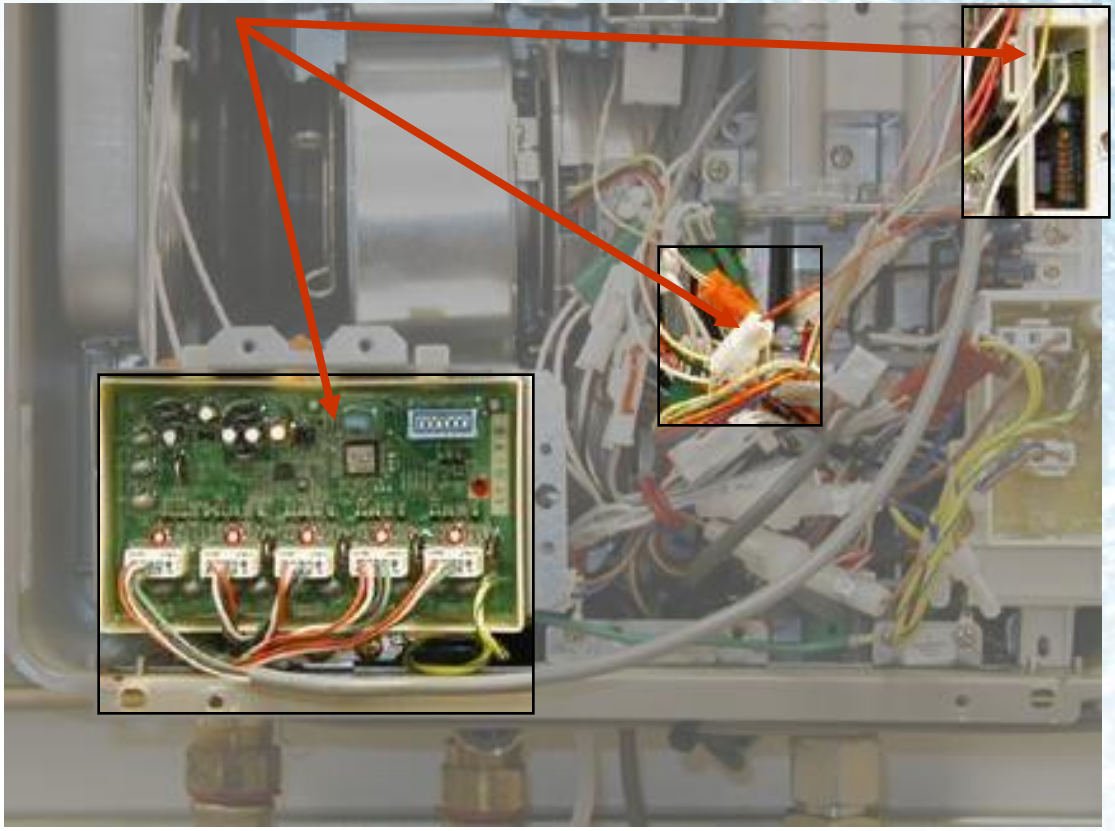
***Contact Rinnai for more information**

Multiple Unit Operation

MSA - 2M Master Board / MSA-2S wiring harness connections

In an MSA configuration, a special harness connects to the MSA controller board (left arrow), a single red wire (middle arrow), and each unit's PCB (right arrow).

NOTE: With any MSA or EZConnect™ configuration, the temperature remote connected to the primary or #1 unit will control temperature on ALL units in the system. Remotes on other units in the system will only display (not change) the temperature. They will also display individual diagnostic codes.

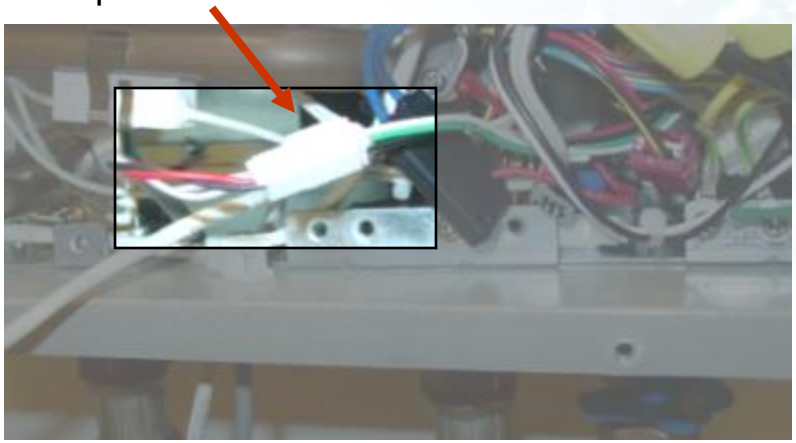


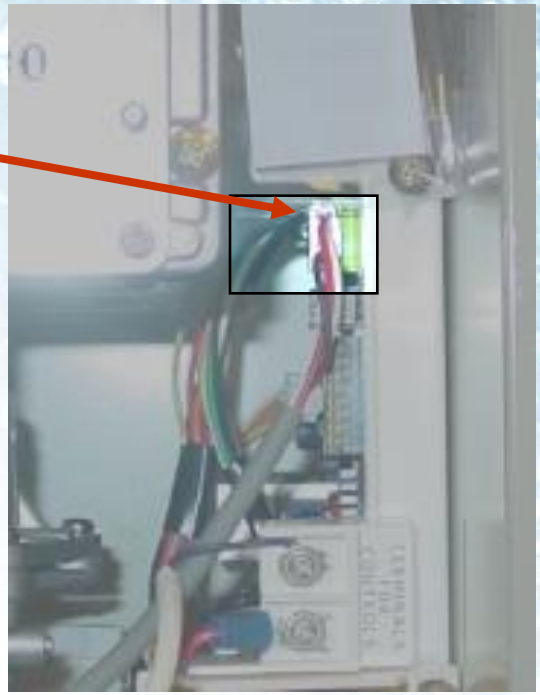
Important: LS units in an MSA or EZConnect™ setup installed in an application needing temperatures higher than 140° F will require an MCC-91 controller installed on the primary unit and either no controller or MCC-91 controllers on all other units.

Multiple Unit Operation

EZConnect™ wiring harness connections

When manifolding two LS Series model water heaters, an MSA board is not necessary. An EZConnect™ cable can be used connecting to a special harness on the primary unit (picture below) and the PCB on the secondary unit (picture to right). Three or more of these models will require the MSA components.



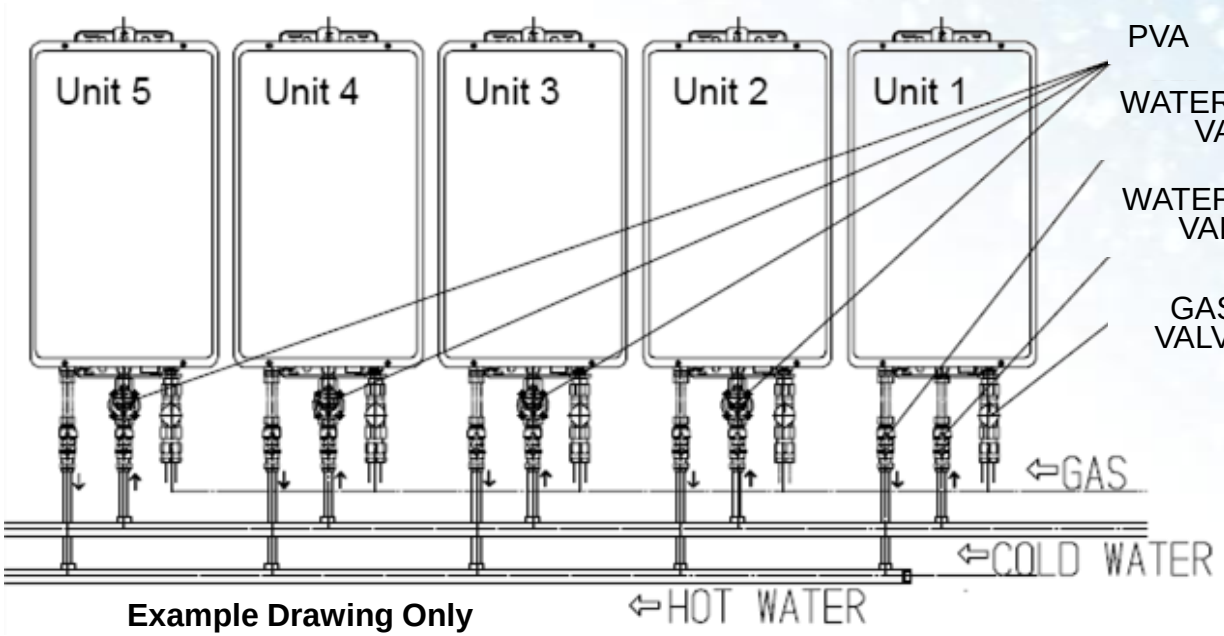


NOTE: With any MSA or EZConnect™ configuration, the temperature remote connected to the primary or #1 unit will control temperature on ALL units in the system. Remotes on other units in the system will only display (not change) the temperature. They will also display individual diagnostic codes.

Important: LS units in an MSA or EZConnect™ setup installed in an application needing temperatures higher than 140° F will require an MCC-91 controller installed on the primary unit and either no controller or MCC-91 controllers on all other units.

R63LSe / V53e Manifold / PVA Application

- The R63LSe and V53e are not compatible with the EZConnect™ or MSA system. To manifold these units a PVA (pressure activation valve) must be used to produce a stable water temperature and allow the water heaters to run efficiently.
- In a manifold system, a PVA is required on all but one unit.



Example Drawing Only

The stopper of each PVA Valve is uniquely set to allow proper activation

Tankless Valve Kit

- Rinnai recommends the use of a tankless valve kit when connecting the water lines to the water heater
- Use of this kit will assist in flushing the heat exchanger in areas where water quality issues exist, as well as improve overall product serviceability
- Make certain the Pressure Relief Valve has appropriate pressure and BTU rating. R98 series must use a PRV value rated no less than 237,000 Btu's

Section Review

1. **Rinnai isolation valve kits are recommended for the following reasons:**
   A. Ease of service (ability to flow water without structural plumbing)
   B. Future maintenance (ability to flush water heater)
   C. Code adherence (installation of properly sized pressure relief valve)
   D. All of the above

   Rinnai isolation kits (kits are model dependent) provide all of the above benefits

2. **A load bearing header must be installed above all recess boxes. (True/False)**

   False. *In most cases, only the recess box for the R98 LSe water heater will require the installation of a load bearing header*

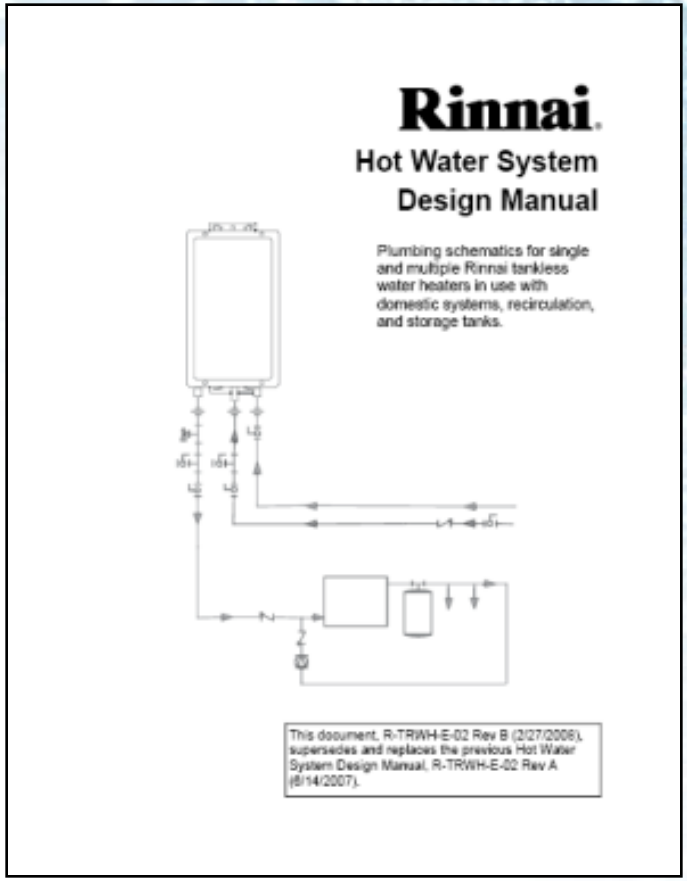
3. **Which of the below is the recommended accessory for installing two R94 LSi water heaters?**
   A. An MSA-2M
   B. An EZConnect™ cable
   C. A PVA kit

   While an MSA-2M will provide the same performance and benefits, the EZConnect™ cable is the most cost effective accessory for two R94 LSi water heaters

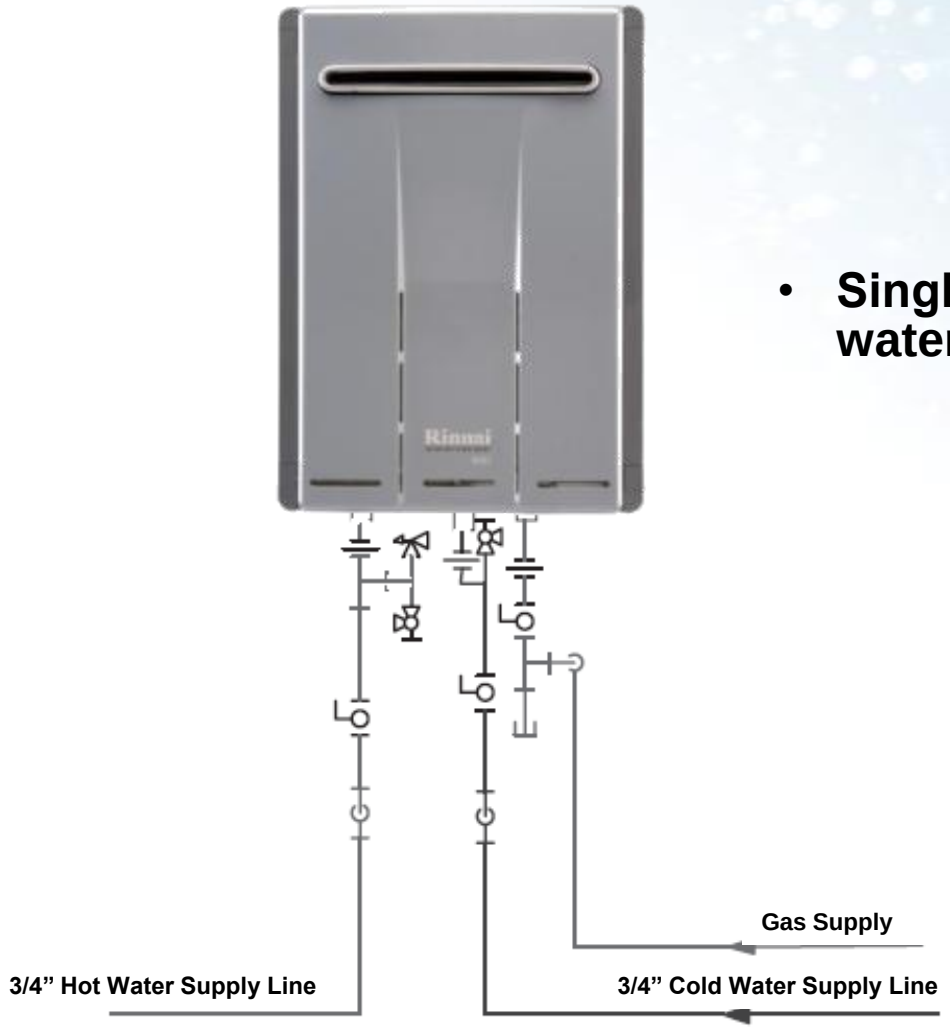
VARIOUS INSTALLATION DRAWINGS

Rinnai's Engineering / Application department is available for assistance in sizing residential and commercial projects. Please call 1-800-621-9419.

- DO NOT use the following drawings for piping systems. These are only intended to be used as examples, and may not include all the components needed for all applications.
- For additional drawings and sizing information please review the Rinnai Hot Water System Design Manual available or Rinnai's sizing calculators available at www.rinnai.us or by calling 1-800-621-9419.
- It is the engineer / contractors responsibility to ensure that installation is in accordance with all local and state building codes. Confer with your local building officials before installation.


Rinnai
Hot Water System
Design Manual
Plumbing schematics for single and multiple Rinnai tankless water heaters in use with domestic systems, recirculation, and storage tanks.
This document, R-TRWH-E-02 Rev B (2/27/2008), supersedes and replaces the previous Hot Water System Design Manual, R-TRWH-E-02 Rev A (8/14/2007).

Piping – Standard Installation

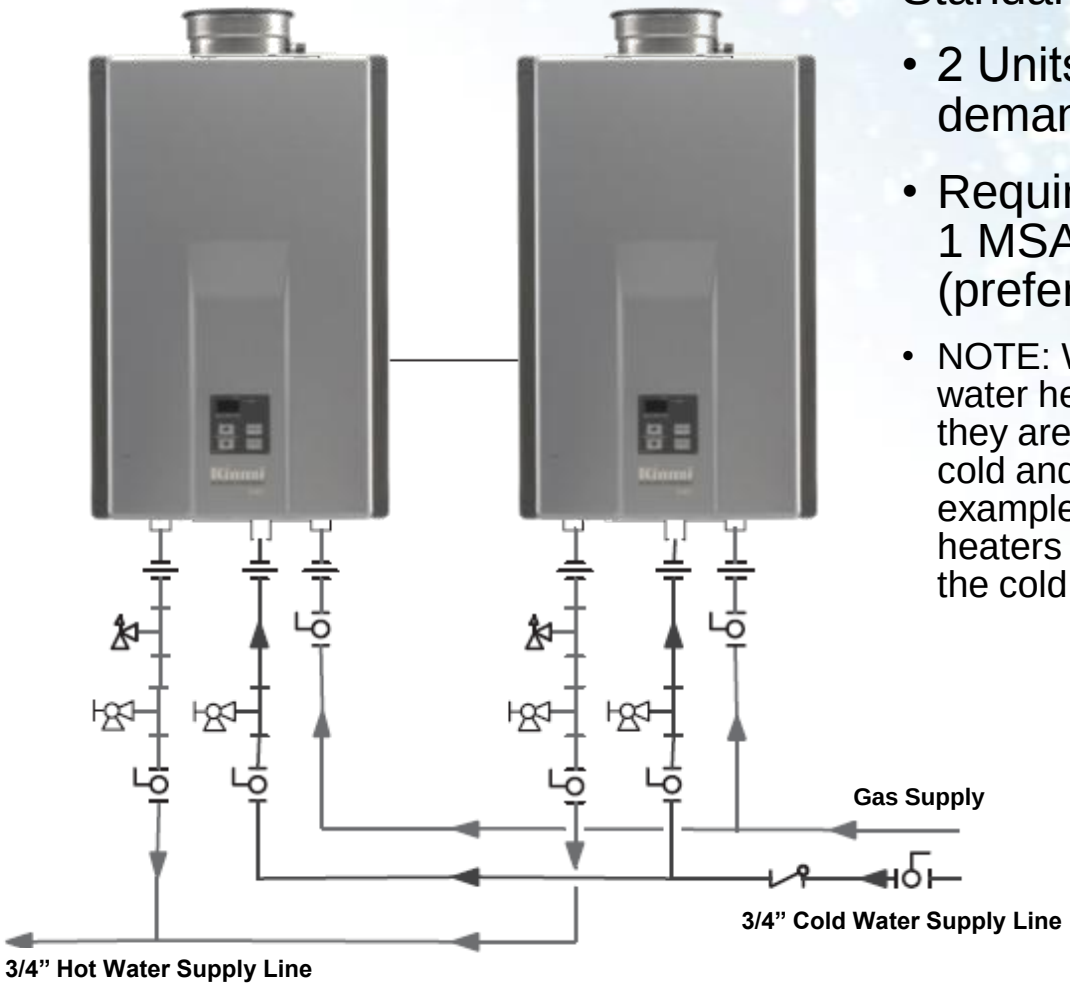


Standard Installation

- **Single Unit based on structure’s hot water demand (bathrooms / fixtures)**

Example Drawing Only

Piping – Multi Unit Application

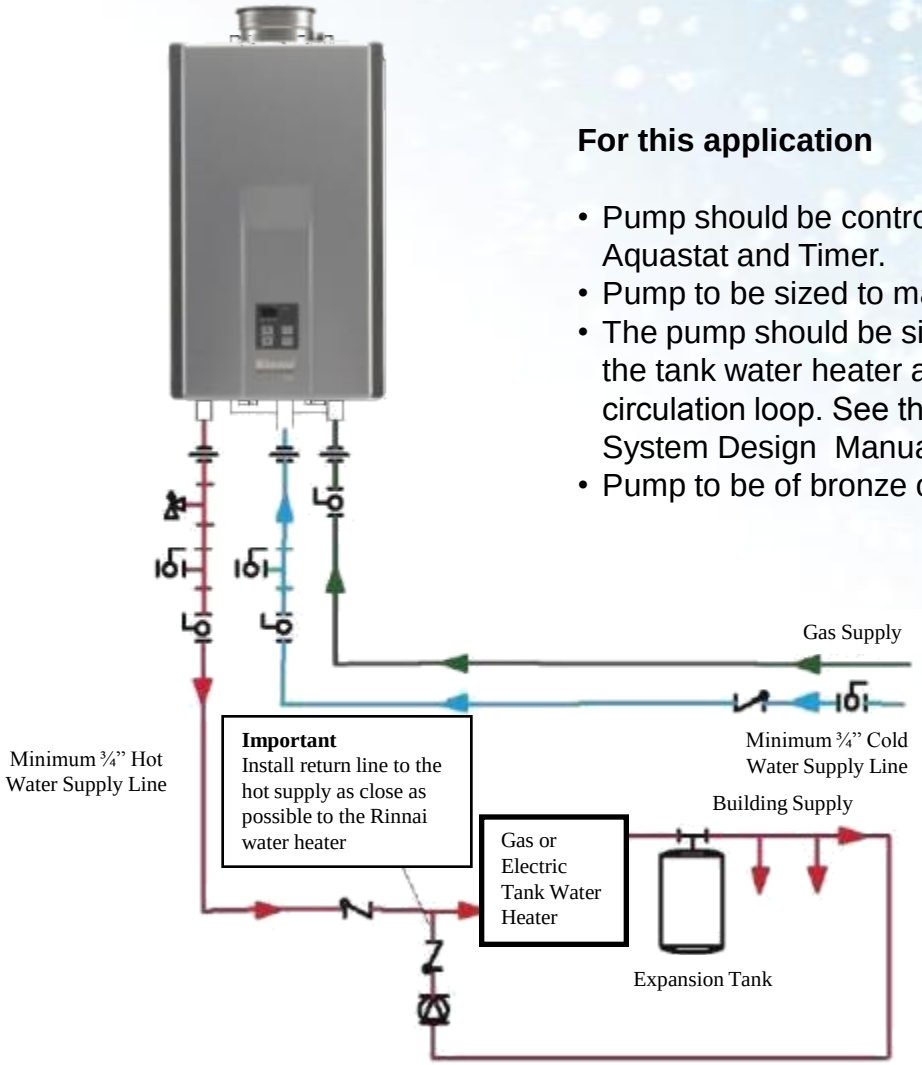


Standard Installation

- 2 Units based on structure’s hot water demand (bathrooms / fixtures)
- Required accessories:
  1 MSA-2M or 1 EZConnect™ Cable (preferred)
- NOTE: When using two or more Rinnai tankless water heaters in the same plumbing system, they are always to be piped in parallel (common cold and common hot lines)—as shown in this example. Never pipe Rinnai tankless water heaters in series (hot outlet of one unit enters the cold inlet of another).

Example Drawing Only

Recommended Piping-Recirculation


Gas Supply
Minimum ¾" Cold Water Supply Line
Minimum ¾" Hot Water Supply Line
Important
Install return line to the hot supply as close as possible to the Rinnai water heater
Building Supply
Gas or Electric Tank Water Heater
Expansion Tank

For this application

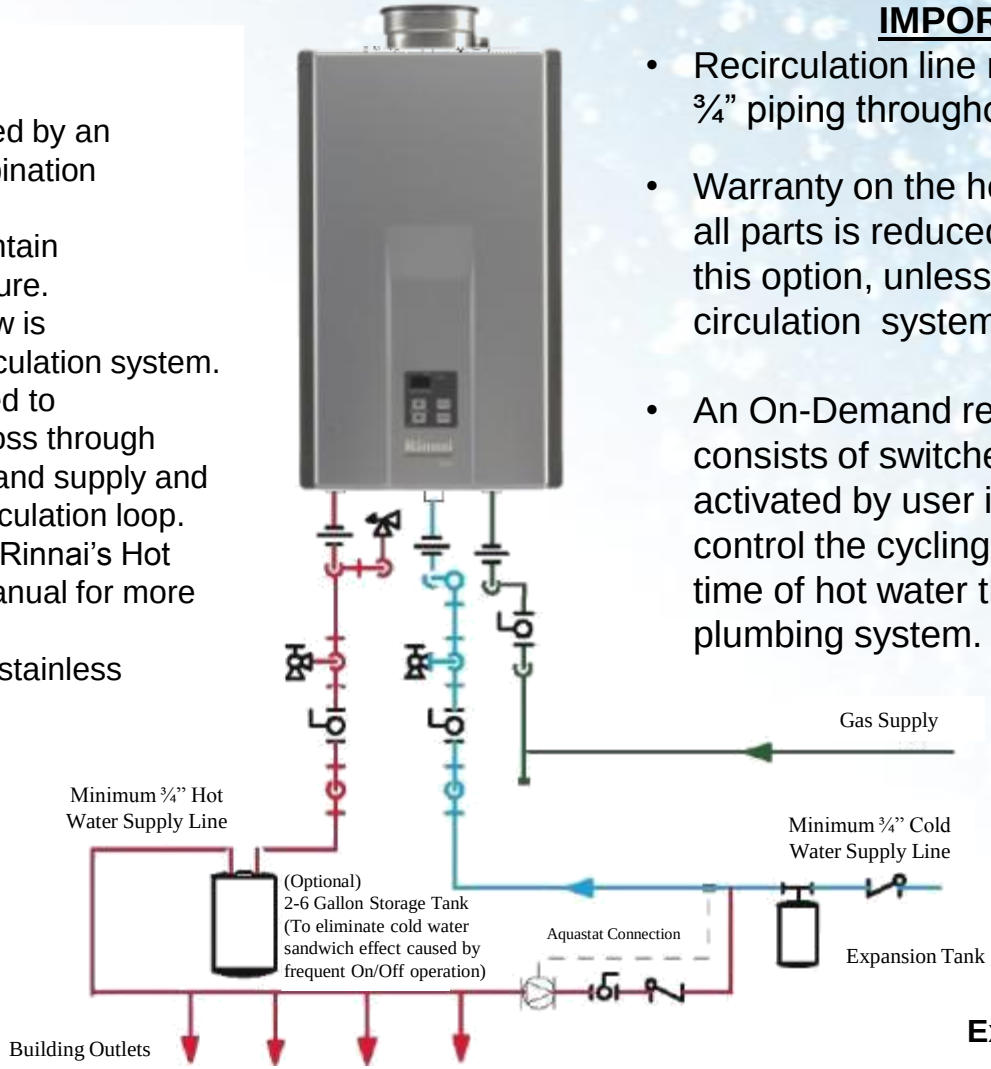
- Pump should be controlled by an Aquastat, Timer, or combination Aquastat and Timer.
- Pump to be sized to maintain circulation loop temperature.
- The pump should be sized to overcome the pressure loss through the tank water heater and supply and return plumbing in the circulation loop. See the latest release of Rinnai's Hot Water System Design Manual for more information.
- Pump to be of bronze or stainless construction.

Example Drawing Only

Optional Piping-Recirculation

For this application

- Pump should be controlled by an Aquastat, Timer, or combination Aquastat and Timer.
- Pump to be sized to maintain circulation loop temperature.
- A minimum of 3 GPM flow is recommended for the circulation system.
- The pump should be sized to overcome the pressure loss through the Rinnai, storage tank and supply and return plumbing in the circulation loop. See the latest release of Rinnai's Hot Water System Design Manual for more information.
- Pump to be of bronze or stainless construction.


Gas Supply
Minimum ¾" Hot Water Supply Line
Minimum ¾" Cold Water Supply Line
(Optional)
2-6 Gallon Storage Tank
(To eliminate cold water sandwich effect caused by frequent On/Off operation)
Aquastat Connection
Expansion Tank
Building Outlets

Example Drawing Only

IMPORTANT

- Recirculation line must be a minimum ¾" piping throughout
- Warranty on the heat exchanger and all parts is reduced to three years with this option, unless an on demand circulation system is installed.
- An On-Demand recirculation system consists of switches or motion sensors activated by user intervention to control the cycling time and circulation time of hot water throughout the plumbing system.

Circulation System

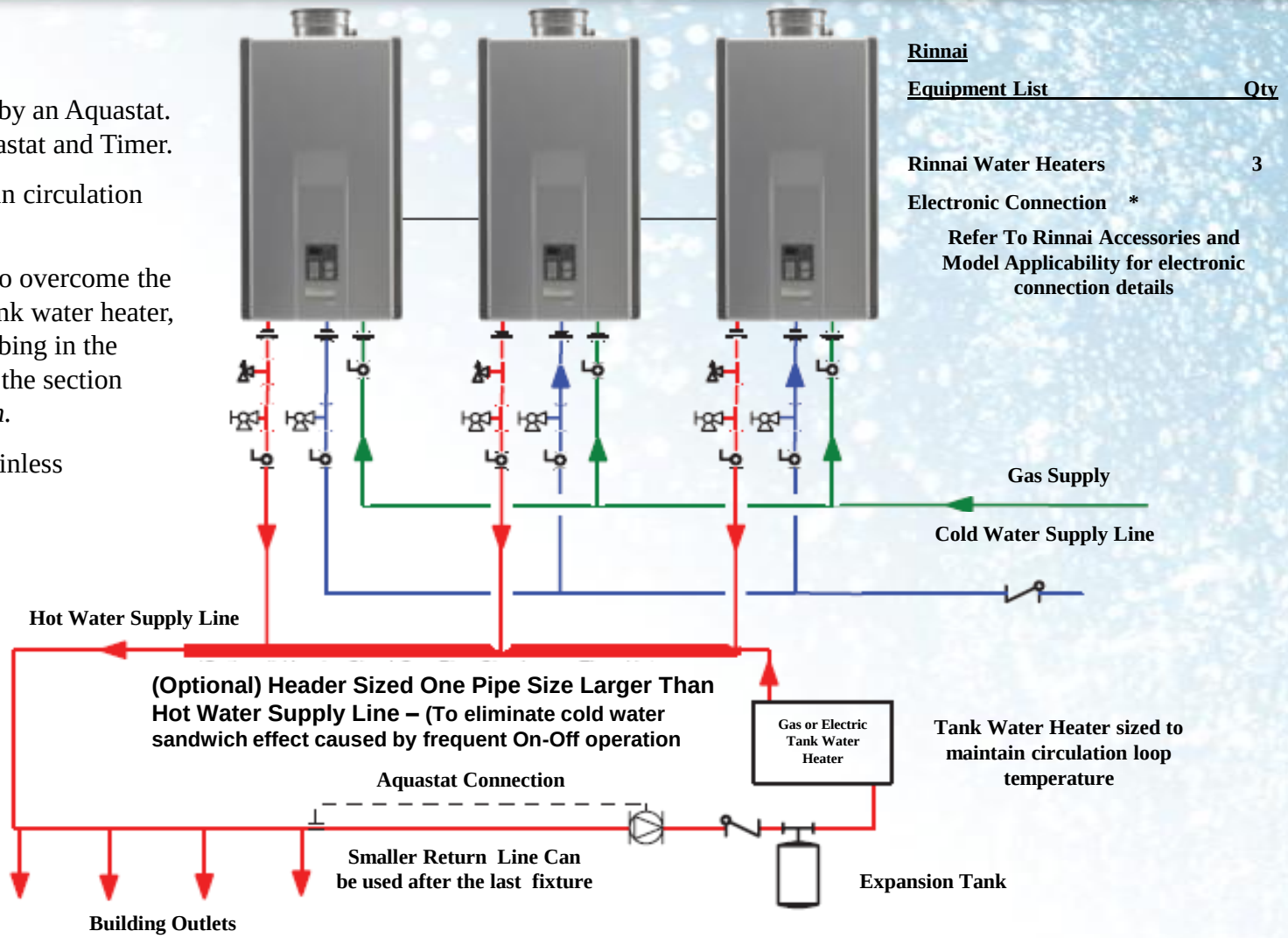
For this application:

Pump should be controlled by an Aquastat. Timer or Combination Aquastat and Timer.

Pump to be sized to maintain circulation loop temperature.

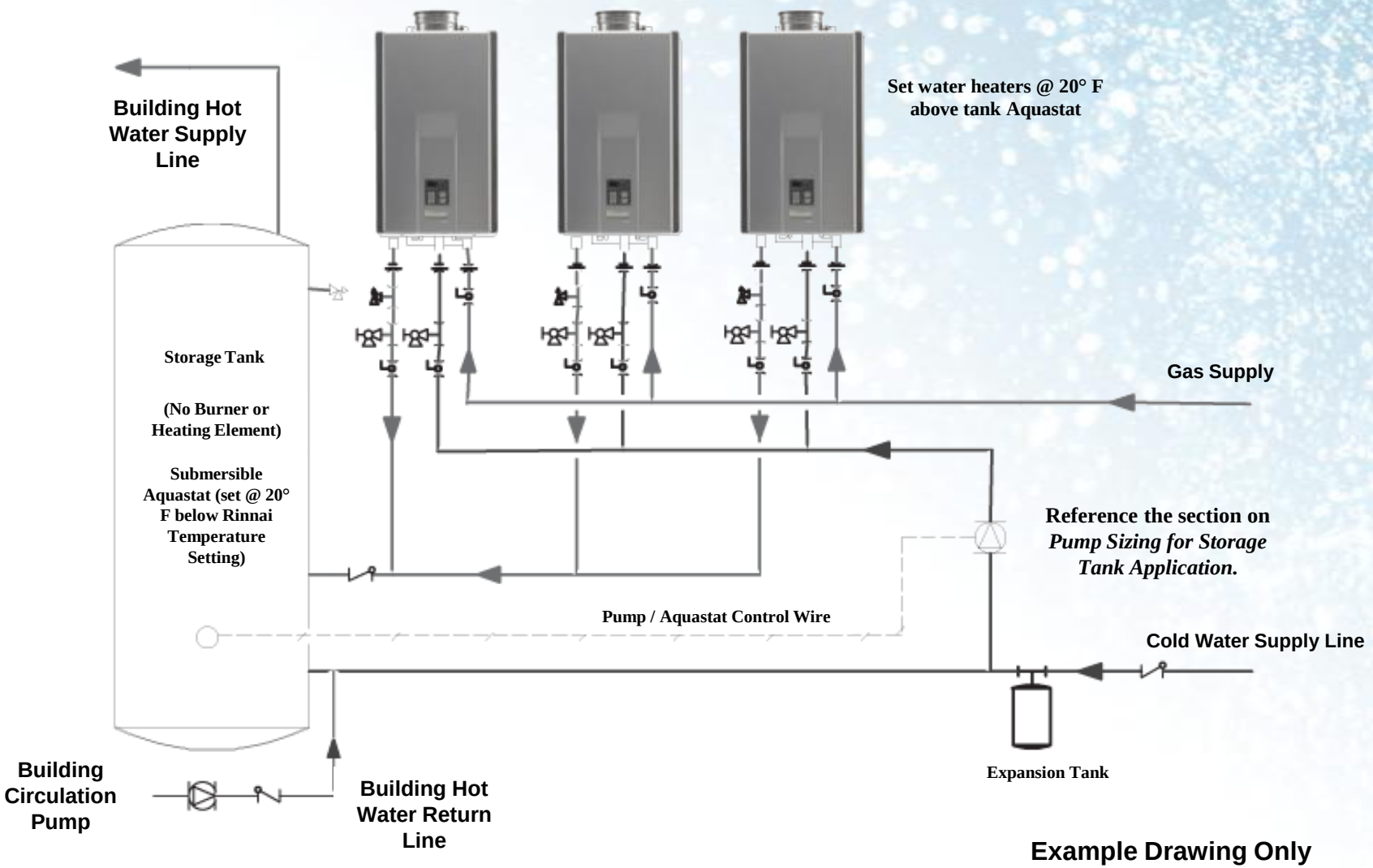
The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop. Reference the section *Pump Sizing for Circulation.*

Pump to be of bronze of stainless construction.


Rinnai
Equipment List Qty
Rinnai Water Heaters 3
Electronic Connection *
Refer To Rinnai Accessories and Model Applicability for electronic connection details
Gas Supply
Cold Water Supply Line
Hot Water Supply Line
(Optional) Header Sized One Pipe Size Larger Than Hot Water Supply Line – (To eliminate cold water sandwich effect caused by frequent On-Off operation
Gas or Electric Tank Water Heater
Tank Water Heater sized to maintain circulation loop temperature
Aquastat Connection
Smaller Return Line Can be used after the last fixture
Expansion Tank
Building Outlets

Example Drawing Only

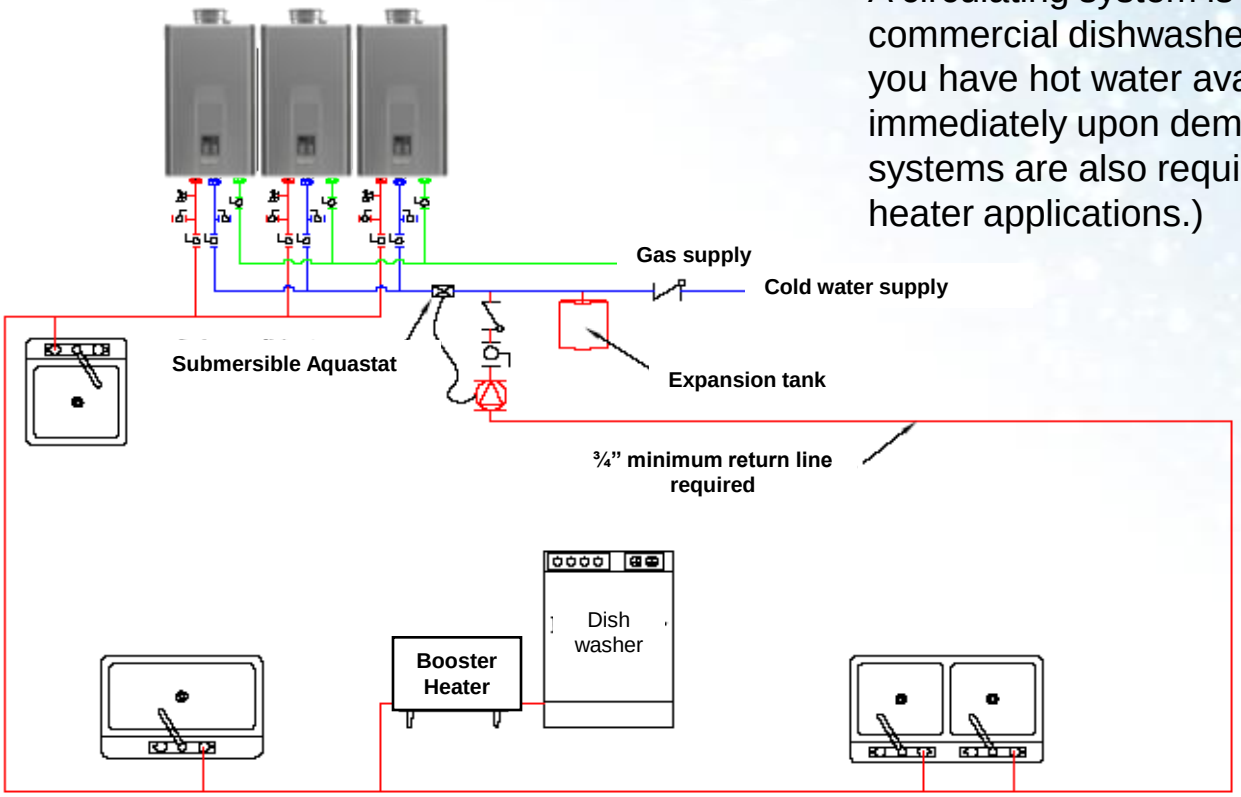
Backup Storage / Circulation


Building Hot Water Supply Line
Set water heaters @ 20° F above tank Aquastat
Storage Tank
(No Burner or Heating Element)
Submersible Aquastat (set @ 20° F below Rinnai Temperature Setting)
Gas Supply
Reference the section on *Pump Sizing for Storage Tank Application.*
Pump / Aquastat Control Wire
Cold Water Supply Line
Expansion Tank
Building Circulation Pump
Building Hot Water Return Line

Example Drawing Only

Commercial Dishwasher Installations

Typically, in applications involving commercial dishwashers, two or more tankless water heaters are needed. Contact Rinnai's Engineering / Applications department for proper sizing in all commercial dishwasher applications. (Have the dishwasher model number available). Below is one of many commercial dishwasher applications.

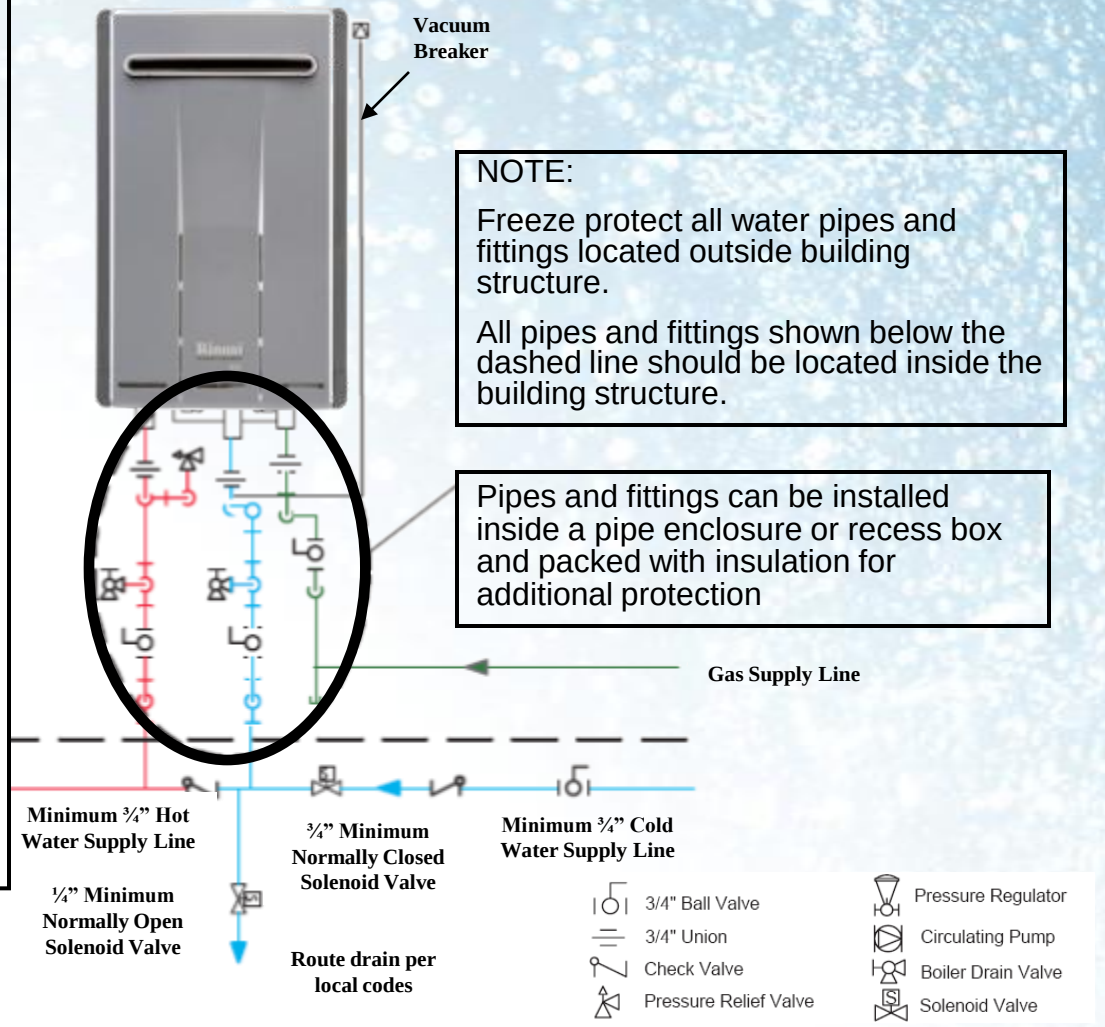


- A circulating system is required in all commercial dishwasher applications to ensure you have hot water available at the dishwasher immediately upon demand. (Circulating systems are also required in similar tank water heater applications.)

- DO NOT use a tankless water heater as a booster heater for commercial dishwashers. When using a tankless water heater in conjunction with a hot water sanitizing type dishwasher, a booster heater recommended by the dishwasher manufacturer must be used.

Auto Drain Down / Freeze Protection

- With electrical power and an adequate gas supply supplied to the Rinnai water heater, it will not freeze in environments as cold as -30º F, when protected from direct wind exposure.
- In the event of a power failure at temperatures below freezing, the water heater should be drained of all water to prevent freezing damage.
- The unit may be drained manually or with the installation of optional solenoids as shown.
- An optional drain down kit is offered consisting of:
  - 1-3/4” normally closed solenoid valve
  - 1-1/4” normally open solenoid valve
  - 1 Vacuum breaker
  - A special surge protector for connection of the two solenoids valves. Connection at this point ensures the solenoids will drain the unit under various potential freezing scenarios.


Vacuum Breaker
NOTE:
Freeze protect all water pipes and fittings located outside building structure.
All pipes and fittings shown below the dashed line should be located inside the building structure.
Pipes and fittings can be installed inside a pipe enclosure or recess box and packed with insulation for additional protection
Gas Supply Line
Minimum ¾” Hot Water Supply Line
¼” Minimum Normally Open Solenoid Valve
¾” Minimum Normally Closed Solenoid Valve
Route drain per local codes
Minimum ¾” Cold Water Supply Line
3/4" Ball Valve
3/4" Union
Check Valve
Pressure Relief Valve
Pressure Regulator
Circulating Pump
Boiler Drain Valve
Solenoid Valve

Example Drawing Only

Section Review

1. **Which of the following is the correct method of piping when installing two or more Rinnai tankless water heaters in the same plumbing system?**

   A. Parallel plumbing (common hot, common cold)

   B. Series plumbing (hot outlet of one water heater enters the cold inlet of another)

   C. Either of the above

   For proper performance, only pipe Rinnai tankless water heaters in parallel

2. **Circulation of hot water into a Rinnai water heater (as shown in the optional circulation method) can reduce the warranty. (True/False)**

   True. *Circulation that causes hot water to re-enter a Rinnai tankless water heater will reduce the parts and heat exchanger warranty to three years. The preferred method of circulation prevents this reduction of the warranty.*

3. **Rinnai tankless water heaters are approved for use as commercial dishwasher booster heaters (True/False)**

   False*. While Rinnai tankless water heaters can be used as a supply for commercial dishwashers, they should never be used as an initial booster.*

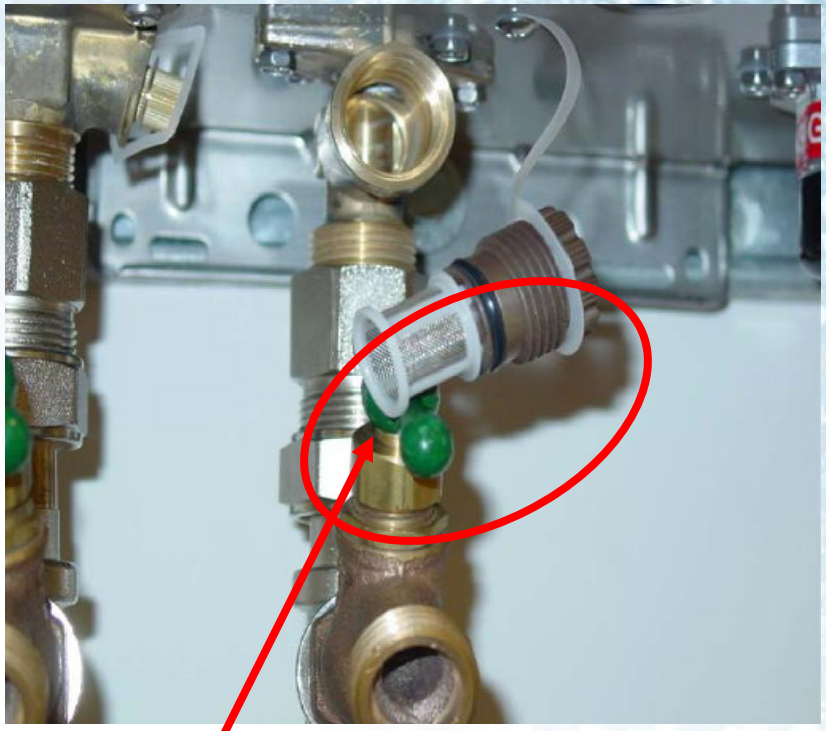
MAINTENANCE

&

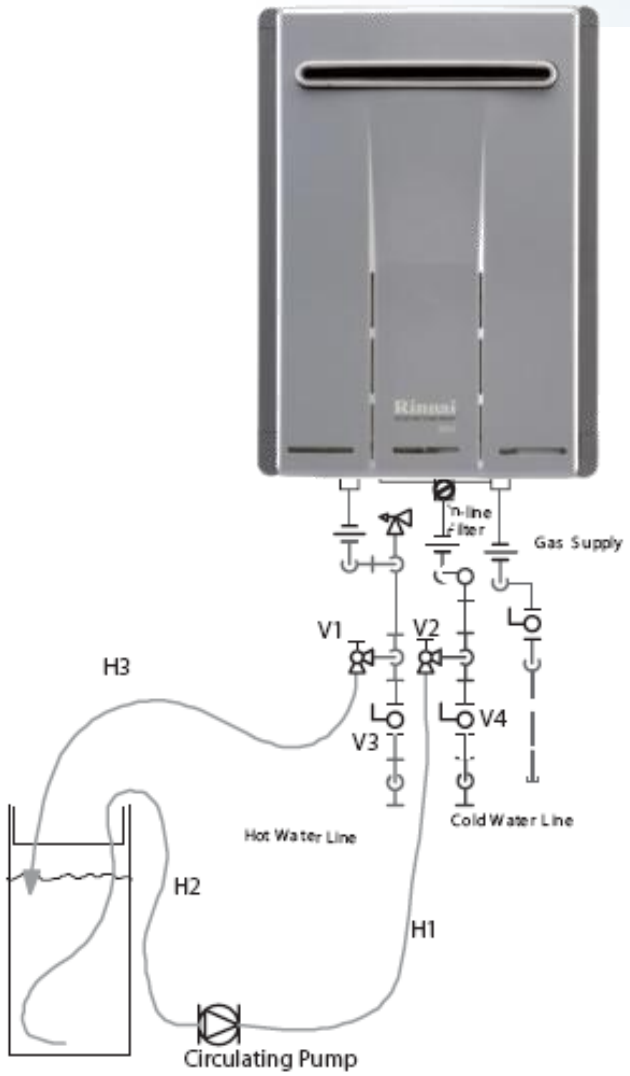
WARRANTY

Maintenance – Inlet Water Filter

- Rinnai recommends that the inlet water filter be cleaned before the initial operation of a new unit.
- Before removing the inlet filter, ensure that the water supply has been turned off, and all pressure in the hot water system has been drained off by opening a hot water tap to ensure no water is flowing.
- See filter location in picture at right.
- The filter assembly should be hand tightened only.



Maintenance – Service Flush Procedure



For proper operation, unit longevity, and warranty adherence, water supply to the water heater must meet National Secondary Drinking Water Regulations. In areas with hard water, a water softener or other conditioning may be needed. A periodic flushing procedure may also be required. Below is the proper flushing procedure:

1. Disconnect electrical power to the water heater
2. Close the shutoff valves on both the hot and cold water lines (V3 and V4)
3. Connect pump outlet hose (H1) to the cold water line at service valve V2
4. Connect drain hose (H3) to service valve V1
5. Pour approximately 4 gallons of virgin food grade white vinegar or citric acid into pail
6. Place the drain hose (H3) and the hose (H2) to the pump inlet into the cleaning solution
7. Open both service valves (V1 and V2) on the hot and cold water lines
8. Operate the pump and allow the cleaning solution to circulate through the water heater for at least 45 minutes
9. Turn off the pump
10. Rinse the cleaning solution from the water heater by:
    a. Remove the free end of the drain hose (H3) from the pail
    b. Close service valve, V2, and open shutoff valve, V4. Do not open shutoff valve, V3.
    c. Allow water to flow through the water heater for 5 minutes
    d. Close service valve, V1, and open shutoff valve, V3
11. Disconnect all hoses
12. Remove the in-line filter at the cold water inlet and clean out any residue
    a. Place the filter back into the unit
13. Restore electrical power to the water heater

Maintenance Codes

A 2-digit maintenance code will flash on the temperature controller when a fault occurs. The unit will stop operating. Resetting water flow or power will clear the code. See owner's manual for a full detailed list of all codes.

ERROR	FAULT	REMEDY
02	No burner operation during freeze protection mode	- Service Call
03	Power Interruption during Bath Fill (water will not flow when power returns)	- Turn off all hot water taps. Press ON/OFF twice
10	Air supply or Exhaust Blockage	- Ensure Rinnai approved venting materials are being used - Check that nothing is blocking the flue inlet or exhaust - Check all vent components for proper connections - Ensure vent length is well within limits - Ensure condensation collar was installed correctly - Verify dip switches are set properly - Check fan for blockage
11	No Ignition	- Check that the gas is turned on at the water heater, gas meter, or cylinder - Ensure gas type and pressure is correct - Bleed all air from gas lines - Ensure gas line, meter, and / or regulator is sized properly - Verify dip switches are set properly - Ensure appliance is properly grounded - Disconnect all MSA controls - Ensure igniter is operational - Check igniter wiring harness for damage - Check gas solenoid valves for open or short circuits - Remove burner cover and ensure all burners are properly sealed - Remove burner plate and inspect burner surface for condensation or debris

(Continued on next page)

Maintenance Codes

ERROR	FAULT	REMEDY
12	Flame Failure	- Check that the gas is turned on at the water heater, gas meter, or cylinder - Check for obstructions in the flue outlet - Ensure gas type and pressure is correct. Bleed all air from gas lines. - Ensure gas line, meter, and / or regulator is sized properly - Ensure proper Rinnai venting material was installed - Ensure condensation collar was installed properly - Ensure vent length is well within limits - Verify dip switches are set properly - Ensure appliance is properly grounded - Disconnect keypad - Disconnect all MSA controls if installed - Check power supply for loose connections - Check power supply for proper voltage and voltage drops - Ensure flame rod wire is connected - Check flame rod for carbon build up - Disconnect and reconnect all wiring harnesses on unit and PC board - Check all components for electrical short - Check gas solenoid valves for open or short circuits - Remove burner plate and inspect burner surface for condensation or debris
14	Thermal Fuse	- Check gas type of unit and ensure it matches gas type being used - Check for restrictions in air flow around unit and vent terminal - Check for low water flow in a circulating system causing short cycling - Ensure dip switches are set to the proper position - Check for foreign materials in combustion fan and / or exhaust piping - Check heat exchanger for cracks and/or separations - Check heat exchanger surface for hot spots which indicates blockage due to scale build up. Refer to instructions in manual for flushing heat exchanger - Measure resistance of safety circuit - Ensure high fire and low fire manifold pressure is correct - Check for improper conversion of product
16	Over Temperature Warning	- Check gas type of unit and ensure it matches gas type being used - Check for low water flow in a circulating system causing short cycling - Check for foreign materials in combustion fan and/or exhaust piping - Check for clogged heat exchanger

(Continued on next page)

Maintenance Codes

ERROR	FAULT	REMEDY
32	Outgoing Water Temperature Sensor Faulty	- Check sensor wiring for damage - Measure resistance of sensor - Clean sensor of scale build-up - Replace Sensor - Check for restrictions in air flow around unit and vent terminal. (Code 34 only)
33	Heat Exchanger Outgoing Temperature Sensor Faulty	
34	Combustion Air Temperature Sensor Faulty	
52	Modulating Solenoid Valve Signal Abnormal	- Check modulating gas solenoid wire harness for loose or damaged terminals - Measure resistance of valve coil
61	Combustion Fan Failure	- Ensure fan will turn freely - Check wiring harness to motor for damaged and/or loose connections - Measure resistance of motor windings
65	Water Flow Servo Faulty (Does not stop water properly)	- Check water flow servo wiring harness connection - Measure resistance of water flow servo wiring If blank screen is present on temperature control, the water flow servo has shorted out. Unplug water flow servo. If numbers appear on the digital temperature controller and unit starts operating, replace water flow servo.
71	SV0, SV1, SV2, and SV3 Solenoid Valve Circuit Faulty	- Check wiring harness to all solenoids for damaged and/or loose connections - Measure resistance of each solenoid valve coil
72	Flame Sensing Device Faulty	- Ensure flame rod is touching flame when unit fires - Check all wiring to flame rod for damage - Remove flame rod and check for carbon build-up, clean with sand paper - Check inside burner for any foreign material blocking flame at flame rod - Measure micro-amp output of sensor circuit with flame present - Replace flame rod
LC (00)	Scale Build-up in Heat Exchanger (When checking maintenance code history, “00” is substituted for “LC”)	- Flush heat exchanger. Refer to instructions in manual. - Replace heat exchanger
No Code	Nothing happens when water flow is activated.	- Clean inlet water supply filter - On new installations, ensure hot and cold water lines are not reversed - Check for bleed over. Isolate unit from building by turning off hot water line to building. Isolate circulating system. If present - Open pressure relief valve, if unit fires there is bleed over in plumbing. - Ensure turbine spins freely - Measure the resistance of the water flow control sensor - Ensure minimum flow rate to fire unit is present - Remote control does not light up but 12VDC is present at temperature controller

Current Model Production Product Warranty

Residential			Commercial		
Heat Exchanger	Parts	Labor	Heat Exchanger	Parts	Labor
12	5	1	5	5	1

3-year heat exchanger and parts warranty when water heater is installed in a circulation loop or system, or in a series where all water flows through the water heater, and where an on demand system is not incorporated.

- If an LS Series unit is used in a commercial application, the commercial warranty will apply
- If an LS Series is in conjunction with a Rinnai Air Handler, the heat exchanger is warranted for 10 years and all other parts are warranted for 5 years
- V53e has 10 year heat exchanger warranty

KEY POINTS OF WARRANTY COVERAGE

- Warranty covers any defects in materials or workmanship when the product is installed and operated according to Rinnai written installation instructions
- Warranty applies only to products that are installed per local and/or state codes. Improper installation my void the warranty.
- Warranty doesn't cover failure due to accident, abuse, misuse, alteration, misapplication, acts of God, improper installation, maintenance, or service, inadequate water quality, scale buildup, or freeze damage
- Warranty doesn't cover any product used as a pool or spa heater. Warranty does cover bathroom whirlpool tubs.
- Warranty does not cover products where the water supply does not meet the National Secondary Drinking Water Regulations.

Section Review

1. **The warranty for a Rinnai tankless water heater does not apply to which of the following?**
   - A. Acts of God
   - B. Improperly installed units
   - C. Units used in an incorrect application (misapplication)
   - D. Units installed by an individual not licensed or qualified to do so
   - E. All of the above

2. **To reset an error code on a Rinnai tankless water heater:**
   - A. Turn off water
   - B. Turn off power (and turn on again)
   - C. Press the “reset” button on the controller
   - D. Either A or B

   Turning of water or recycling power will clear and reset an error code. There is not a “reset” button.

3. **Where is the location of the inlet water filter on a Rinnai tankless water heater?**
   - A. On the hot water outlet under the unit
   - B. On the cold water inlet under the unit
   - C. Inside the unit

   The inlet water filter is directly under the unit on the cold water inlet.

RESIDENTIAL APPLICATIONS

2008 HGTV Green Home

Show Village Home

COMMERCIAL APPLICATIONS

Commercial Application

Commercial Application

Commercial Applications

Commercial Application

- 5 R94LSe at a Quality Inn Hotel
  - Location - Victoria, TX
- 38 rooms
- Laundry facility
- Replaced a 69 gallon tank water heater @ 500,000 Btu
- Rinnai products installed due to a 10 – 12 week lag time to have the custom tank built

APPENDIX A

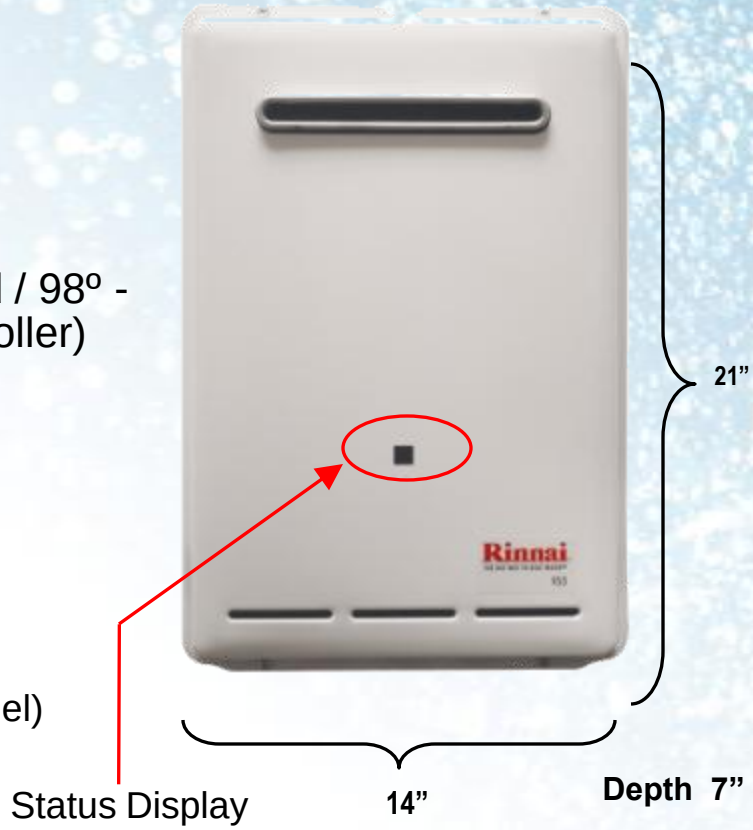
CURRENT MODEL PRODUCTION OVERVIEW

EXTERNAL PRODUCT INFORMATION

V53e External Unit

- **Product Number: V53e**
- **Rinnai Model Number: REU-VAM1620W**
  (not part of the LS Series)
- Btu/h: 19,000 – 120,000 (Natural Gas)
  20,200 – 120,000 (Propane)
- Water Flow Rate: .6 – 5.3 GPM at a 35º F rise
- Temperature: 120º or 140º F (no controller included / 98º - 140º F with purchase of optional temperature controller)
- Application Requirement: Residential Only
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 82%
- Water Flow Control: Fixed By-pass control
- Accessories – Pipe Cover, Recess Box

  - MC-91 Temperature Controller (not included with this model)
  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller



NOTE: The V53 does not have the ability to connect an MSA controller or EZConnect™ Cable. When manifolding these products you must use Rinnai's PAM valves (pt. #REU-PVA-1).

R63LSe External Unit

- **Product Number – R63LSe**
- **Rinnai Model Number – REU-VA2024WD**
- Btu/h: 21,500 – 150,000 (Natural Gas)
- Btu/h: 20,600 – 150,000 (Liquid Propane)
- Water Flow Rate – .6 – 6.3 GPM at a 35º F rise
- Temperature Controller – MC-91 (included)
- Temperature Range: 98º - 140º F
  (without temperature controller 120º factory default)
  - 98º - 160º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .81 natural gas / propane
- Thermal Efficiency: 83%
- Water Flow Control: Water Flow Servo, Fixed By-Pass control
- Accessories: Pipe Cover, Recess Box
  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

NOTE: The R63LSe does not have the ability to connect an MSA controller or EZConnect™ Cable. When manifolding these products you must use Rinnai’s PAM valves (pt. #REU-PVA-1).

R75LSe External Unit

- **Product Number – R75LSe**
- **Rinnai Model Number – REU-VA2528WD**
- Btu/h: 15,000 – 180,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 7.5 GPM at a 35º F rise
- Temperature Controller: MC-91 (included)
- Temperature Range: 98º - 140º F (without temperature controller 120º factory default)
  - 98º - 160º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 83%
- Water Flow Control: Water Flow Servo, Fixed By-Pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover, Recess Box

- MC-100 Deluxe Temperature Controller
- BC-100 Bathroom Temperature Controller
- MC-502-RC Wireless Temperature Controller
- MCC-91 Temperature Controller for Commercial or Hydronic applications

R94LSe External Unit

- **Product Number – R94LSe**
- **Rinnai Model Number – REU-VA2535WD**
- Btu/h: 15,000 – 199,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 9.4 GPM at a 35º F rise
- Temperature Controller: MC-91 included
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default temperature)
  - 98º - 185º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 83%
- Water Flow Control: Water Flow Servo, Variable By-Pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover, Recess Box

- MC-100 Deluxe Temperature Controller
- BC100 Bathroom Temperature Controller
- MC-502-RC Wireless Temperature Controller
- MCC-91 Temperature Controller for Commercial or Hydronic applications

R98LSe External Unit

- **Product Number – R98LSe or R98LSe ASME***
- **Rinnai Model Number – REU-VA3237WD**
- Btu/h: 19,000 – 237,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 9.8 GPM at a 35º F rise
- Temperature Controller: MC-91 included
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default)
  - 98º - 185º F available with the MCC-91 controller for commercial or hydronic applications
- Thermal Efficiency: 85%-NG 83%-LPG
- Water Flow Control: Water Flow Servo, Variable By-Pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover, Recess Box
  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

***ASME models are required by many state and/or local codes**

INTERNAL PRODUCT INFORMATION

R50LSi Internal Unit

- **Product Number: R50LSi**
- **Rinnai Model Number: REU-VA2019FFUD**
- Btu/h: 15,000 – 150,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 5.0 GPM at a 35º F rise
- Temperature Controller: MC-91 (included)
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default)
  - 98º - 160º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 84%
- Water Flow Control: Water Flow Servo, Fixed By-pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover

  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

R75LSi Internal Unit

- **Product Number – R75LSi**
- **Rinnai Model Number – REU-VA2528FFUD**
- Btu/h: 15,000 – 180,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 7.5 GPM at a 35º F rise
- Temperature Controller: MC-91 (included)
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default)
  - 98º - 160º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 84%
- Water Flow Control: Water Flow Servo, Fixed By-Pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover

  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

R94LSi Internal Unit

- **Product Number – R94LSi**
- **Rinnai Model Number – REU-VA2535FFUD**
- Btu/h: 15,000 – 199,000 (Natural Gas)
  15,000 – 190,000 (Propane)
- Water Flow Rate: .6 – 9.4 GPM at a 35º F rise
- Temperature Controller: MC-91 included
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default)
  - 98º - 185º F available with the MCC-91 controller for commercial or hydronic applications
- Energy Factor: .82 natural gas / propane
- Thermal Efficiency: 84%
- Water Flow Control: Water Flow Servo, Variable By-Pass control
- Accessories: EZConnect™, MSA Controller, Pipe Cover
  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

R98LSi Internal Unit

- **Product Number – R98LSi or R98LSi ASME***
- **Rinnai Model Number – REU-VA3237FFUD**
- Btu/h: 19,000 – 237,000 (Natural Gas / Propane)
- Water Flow Rate: .6 – 9.8 GPM at a 35º F rise
- Temperature Controller: MC-91 included
- Temperature Range: 98º - 140º F (without temperature controller 120º F factory default)
  - 98º - 185º F available with the MCC-91 controller for commercial or hydronic applications
- Thermal Efficiency: 84%-NG 85%-LPG
- Water Flow Control: Water Flow Servo, Variable By-Pass Control
- Accessories: EZConnect™, MSA Controller, Pipe Cover
  - MC-100 Deluxe Temperature Controller
  - BC-100 Bathroom Temperature Controller
  - MC-502-RC Wireless Temperature Controller
  - MCC-91 Temperature Controller for Commercial or Hydronic applications

***ASME models are required by many state and/or local codes**

Temperature Flow Chart

Hot Water Flow Chart 140º F – 85º F Temperature Rise						
Model No. Temperature Rise (ºF)	R98LSi / e Gallons per Minute	R94LSi / e Gallons per Minute	R75LSi / e Gallons per Minute	R63LSe Gallons per Minute	R50LSi Gallons per Minute	V53e Gallons per Minute
140º	2.8	2.4	2.1	1.8	1.8	N/A
135º	2.9	2.5	2.2	1.8	1.9	N/A
130º	3.0	2.6	2.3	1.9	1.9	N/A
125º	3.2	2.7	2.4	2.0	2.0	N/A
120º	3.3	2.8	2.5	2.1	2.1	N/A
115º	3.4	2.9	2.6	2.2	2.2	N/A
110º	3.6	3.0	2.7	2.3	2.3	N/A
105º	3.8	3.2	2.9	2.4	2.4	1.9
100º	4.0	3.3	3.0	2.5	2.5	2.0
95º	4.2	3.5	3.2	2.6	2.7	2.1
90º	4.4	3.7	3.3	2.8	2.8	2.2
85º	4.7	3.9	3.5	2.9	3.0	2.3

Temperature Flow Chart

Hot Water Flow Chart 75º F – 20º F Temperature Rise						
Model No. Temperature Rise (ºF)	R98LSi / e Gallons per Minute	R94LSi / e Gallons per Minute	R75LSi / e Gallons per Minute	R63LSe Gallons per Minute	R50LSi Gallons per Minute	V53e Gallons per Minute
80º	4.9	4.2	3.8	3.1	3.2	2.4
75º	5.3	4.4	4.0	3.3	3.4	2.6
70º	5.7	4.7	4.3	3.6	3.6	2.8
65º	6.1	5.1	4.6	3.8	3.9	3.1
60º	6.6	5.5	5.0	4.2	4.2	3.3
55º	7.2	6.0	5.5	4.5	4.6	3.6
50º	7.9	6.6	6.0	5.0	5.0	3.9
45º	8.8	7.4	6.7	5.5	5.0	4.4
40º	9.8	8.3	7.5	6.2	5.0	4.9
35º	9.8	9.4	7.5	6.3	5.0	5.3
30º	9.8	9.4	7.5	6.3	5.0	5.3
25º	9.8	9.4	7.5	6.3	5.0	5.3
20º	9.8	9.4	7.5	6.3	5.0	5.3

APPENDIX B

WATER QUALITY MAXIMUM CONTAMINANT LEVELS

Water Contaminant Levels

- Secondary Water Maximum Contaminant Levels

Contaminant	Secondary MCL	Noticeable Effects above the Secondary MCL
Aluminum	0.05 to 0.2 mg/L*	Colored water
Chloride	250 mg/L	Salty taste
Color	15 Color Units	Visible tint
Copper	10. mg/L	Metallic taste; blue-green staining
Corrosivity	Non-Corrosive	Metallic taste; corroded pipes / fixture staining
Fluoride	20. mg/L	Tooth discoloration
Foaming Agents	0.5 mg/L	Frothy, cloudy; bitter taste; odor
Iron	0.3 mg/L	Rusty color; sediment; metallic taste; reddish or orange staining
Manganese	0.05 mg/L	Black to brown color; black staining; biter metallic taste
Odor	3 TON (threshold odor number)	"Rotten-egg", musty or chemical smell
pH	6.5 - 8.5	low pH; bitter metallic taste; corrosion high pH; slippery feel; soda taste; deposits
Silver	0.1 mg/L	Skin discoloration; graying of the white part of the eye
Sulfate	205 mg/L	Salty Taste
Total Dissolved Solids (TDS)	500 mg/L	Hardness; deposits; colored water; staining; salty taste
Zinc	5 mg/L	Metallic Taste
*mg/L is milligrams of substance per liter of water		

Corrosivity, staining related to corrosion, not only affects the aesthetic quality of water, but may also have significant economic implications. Other effects of corrosive water, such as the corrosion of iron and copper, both affecting taste and corrosion of distribution of water supply lines which can reduce water flow.

APPENDIX C

Rinnai supplied venting materials

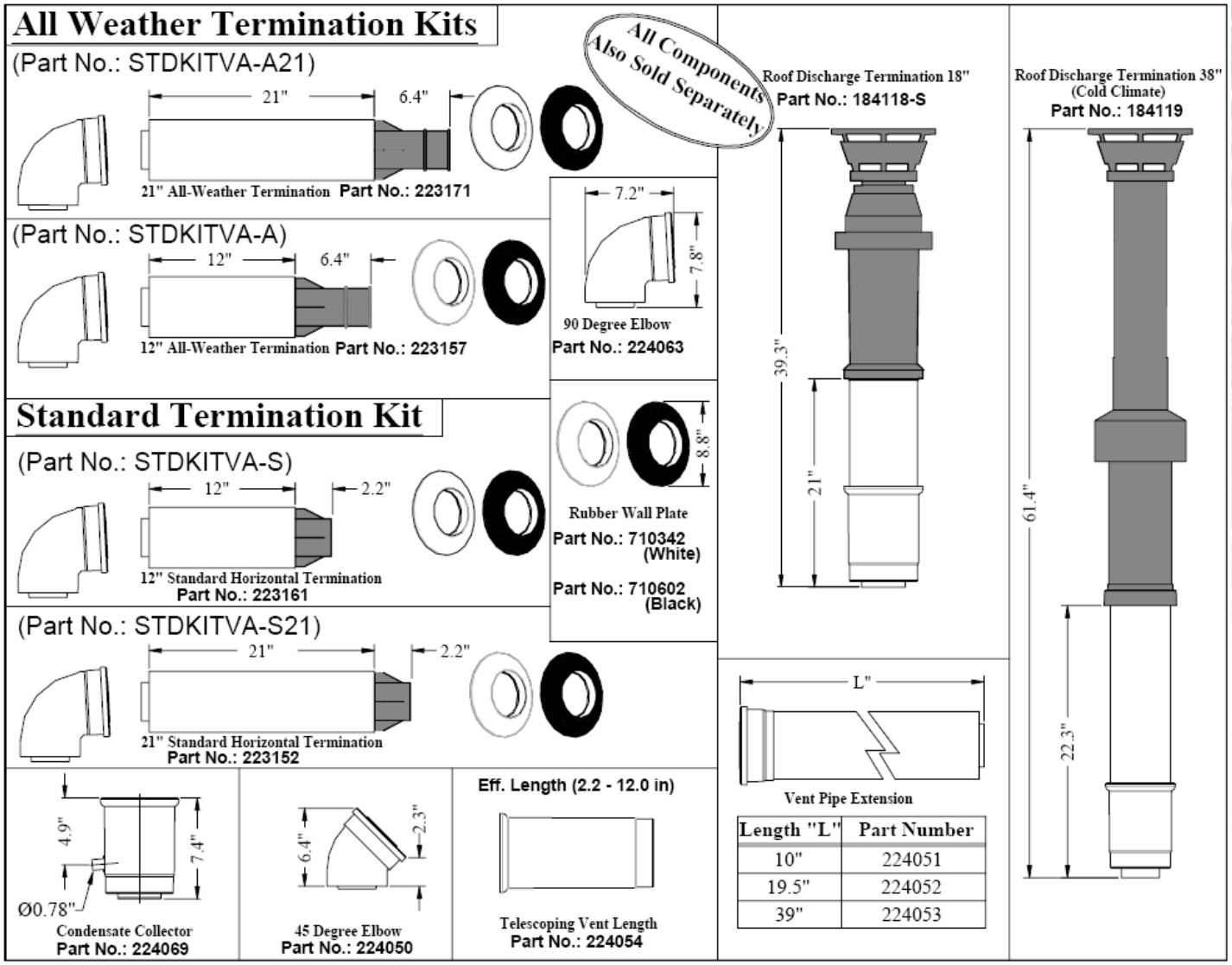
Ubbink parts lists

ProTech parts lists

LSi Plastic Concentric Venting Parts

for R50, R75, & R94 LSi models

Rinnai



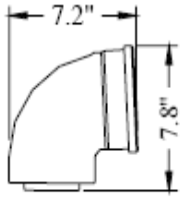
LSi Metal Concentric Venting Parts

for R50, R75, & R94 LSi models

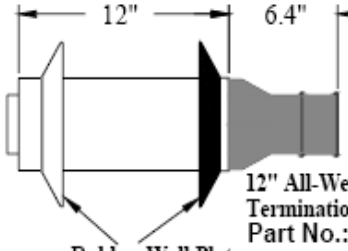
Rinnai

All-Weather Termination Kit (Metal) (Part No.: 223168)

Also Sold Separately



90 Degree Elbow (Metal)
Part No.: 224255

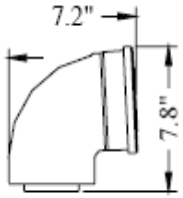


12" All-Weather Horizontal Termination (Metal)
Part No.: 223159

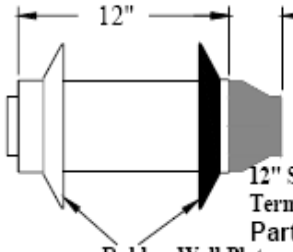
Rubber Wall Plate
Part No.: 710342 (white)
Part No.: 710602 (black)

Standard Termination Kit (Metal) (Part No.: 223167)

Also Sold Separately

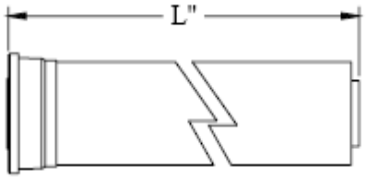


90 Degree Elbow (Metal)
Part No.: 224255



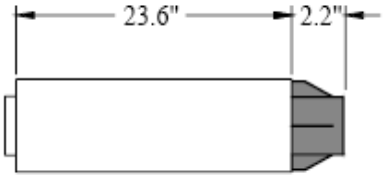
12" Standard Horizontal Termination (Metal)
Part No.: 223165

Rubber Wall Plate
Part No.: 710342 (white)
Part No.: 710602 (black)

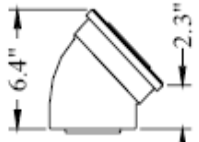


Vent Pipe Extension

Length "L"	Part Number
10"	224260
19.5"	224265
39"	224270



23.6" Standard Horizontal Termination (Metal)
Part No.: 223155

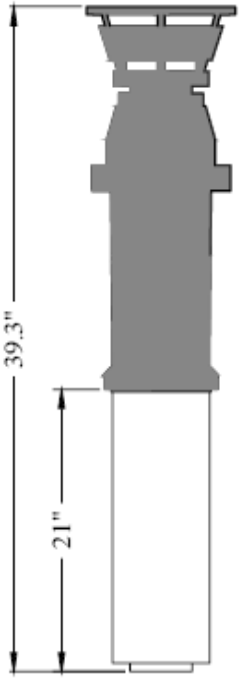


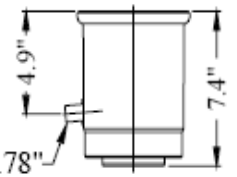
45 Degree Elbow (Metal)
Part No.: 224250

Eff. Length (2.0 - 11.5 in)

Telescoping Vent Length (Metal)
Part No.: 224275

Roof Discharge Termination 18" (Metal)
Part No.: 184127





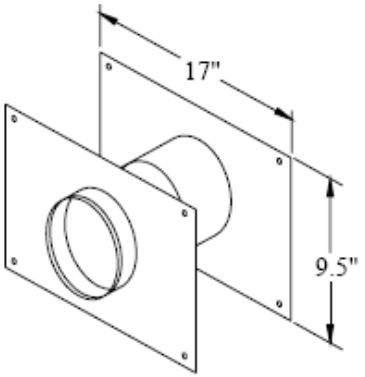
Condensate Collector (Metal)
Part No.: 224245

LSi Venting Accessories

for R50, R75, & R94 LSi models

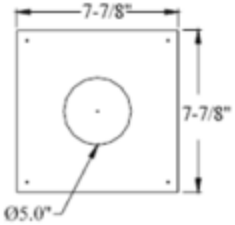
Rinnai

* Fits 2x4 or 2x6 Wall Construction

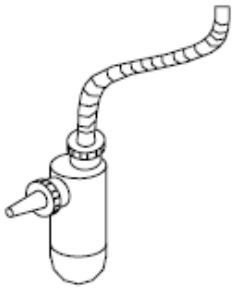


Thimble
Part No.: 224045

Bug Guard
Part No.: 224043

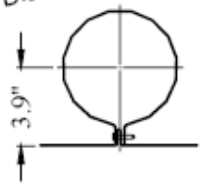


Metal Pass Through Plate
Part No.: 224097



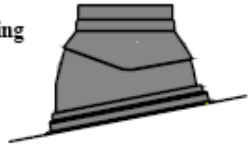
Condensate Trap
Part No.: 222050

* Included with Roof Discharge Terminals



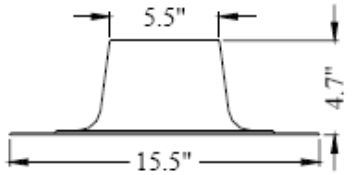
Pipe Clamp
Part No.: 169044

Roof Flashing

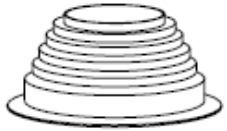


Roof Pitch	Part Number
1/12 to 6/12	189950
6/12 to 12/12	189951
8/12 to 16/12	189952

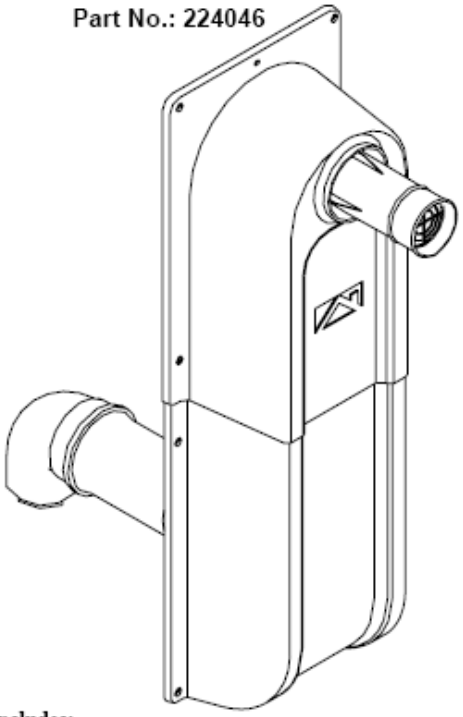
Roof Flashing - Flat
Part No.: 146141



Flashing for Metal Roof
Part No.: 242141



Raised Horizontal Termination Kit "Snorkel"
Part No.: 224046



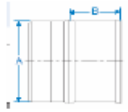
Kit Includes:
14.2" Vent extension, Qty 3 - 90° Elbow, (0224063), Telescopic vent extension (224054), 19.5" Vent pipe extension (224052), Special wall terminal, Cover

Rinnai/ProTech Exhaust Vent System Components

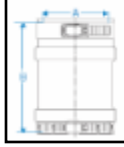
For all R98LSi models

* 4.25Min 8.50Max

Wall Pass Through (for internal walls only)		
A Vent Dia.	B	Part Number
4	10.0	FSWPT4SP

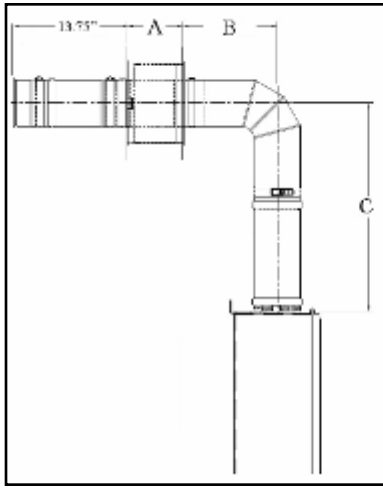


Bird Screen Assembly		
A Vent Dia.	B Eff. Lgth	Part Number
4	2.0	FSBS4SP



Universal Appliance Adapter		
A Vent Dia.	B Eff. Lgth	Part Number
4	5.3	FSAAU4SP

Support Clamp			
A Vent Dia.	B Diameter	C	Part Number
4	4.0	1.5	FSCL4SP



Wall Mount Kit with Birdscreen Termination 4" (Rinnai 3237 Kit)			
A	B	C	Part Number
8.38 - 4.38	13.25 - 9.5	18.25- 14.25	FSWMKBS4

Kit Components

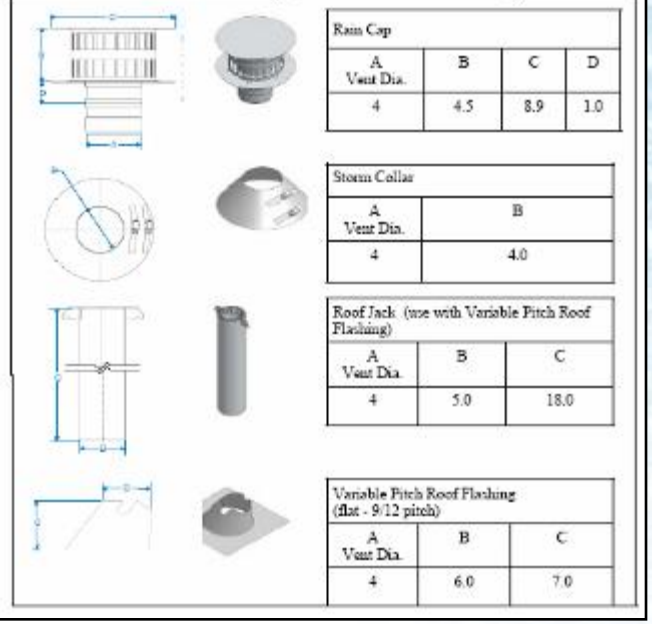
Bird Screen Assembly
Wall Thimble (8.38" - 4.38")
Telescoping Horizontal Length (13.25" - 9.5")
Adjustable Vertical Length (18.25" - 14.25")
Universal Appliance Adapter
12" Vent Length

Part numbers and manufacturer available are subject to change. An appliance adaptor must be the first component connected to the water heater.

Variable Pitch Roof Flashing Kit

Part Number: FSVPK4

Kit Components
Rain Cap
Storm Collar
Roof Jack
Roof Flashing



Rain Cap			
A Vent Dia.	B	C	D
4	4.5	8.9	1.0

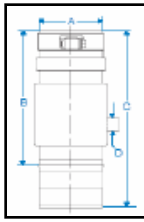
Storm Collar	
A Vent Dia.	B
4	4.0

Roof Jack (use with Variable Pitch Roof Flashing)		
A Vent Dia.	B	C
4	5.0	18.0

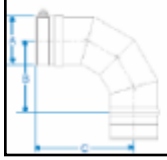
Variable Pitch Roof Flashing (flat - 9/12 pitch)		
A Vent Dia.	B	C
4	6.0	7.0

Rinnai/ProTech Exhaust Vent System Components

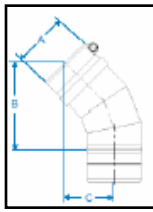
For all R98LSi models



Universal Condensate Drain				
A Vent Dia.	B Eff. Lgth	C	D	Part Number
4	6.4	8.4	.63	FSUCD4SP



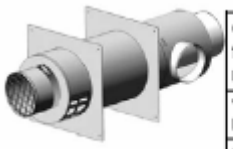
Elbow 90° 4"			
A Vent Dia.	B Eff. Lgth	C	Part Number
4	4.4	6.4	FSELB9004SP



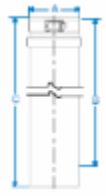
Elbow 45° 4"			
A Vent Dia.	B Eff. Lgth	C	Part Number
4	5.6	3.1	FSELB4504SP

Concentric Termination Kit for when the water heater is mounted directly on termination wall		
Vent Diameter	Fits Wall Thickness	Part Number
7.0	4.25 - 8.37 in	FSDVWMT04LH

Kit includes:
- Bird Screen
- Direct Vent Pass Through (FSDVPTB04LH)
- Exterior & Interior Mounting Plate
- Appliance Adapter
- 3-foot flexible Aluminum Duct with Two Clamps



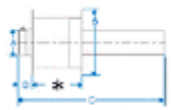
Concentric Termination for when the water heater is mounted remotely from the termination wall		
Vent Diameter	Fits Wall Thickness	Part Number
7.0	4.25 - 8.37 in	FSDVWT4



Adjustable Vent Length			
A Vent Dia.	B Eff. Lgth	C	Part Number
4	2-14	18	FSAVL4SP

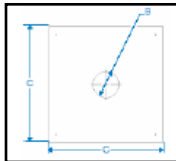
All part renderings and drawings © ProTech Systems Inc.

Vent Length			
A Vent Dia.	B Eff. Lgth	C	Part Number
4	10	12	FSVL1204SP
4	16	18	FSVL1804SP
4	22	24	FSVL2404SP
4	34	36	FSVL3604SP



* 4.25Min 8.50Max

Wall Thimble with Adjustable Vent Length (for external termination)				
A Vent Dia.	B	C	D	Part Number
4	10.0	18.0	2.0	FSWT4SP



Fire Stop / Flat Flashing			
A Vent Dia.	B Diameter	C	Part Number
4	4.4	15	FSFS4SP

Part numbers and manufacturer available are subject to change. An appliance adaptor must be the first component connected to the water heater.

APPENDIX D

SECTION REVIEW ANSWERS

Section Review

Answers for page 8

1. **Rinnai tankless water heaters have a standing pilot? True / False**

   False. *All Rinnai tankless water heaters have electronic ignition*

2. **In order for freeze protection to work correctly, Rinnai tankless water heaters must have which of the following:**

   A. Adequate Water Flow B. Incoming Electricity

   C. Adequate gas supply D. Answers B and C

3. **Which of the following is by definition a residential application?**

   A. A fast food restaurant with a maximum temperature setting of 130°

   B. A condominium where a single tankless water heater is providing hot water for three separate units

   C. A tankless water heater providing domestic hot water and hydronic heat in a single family dwelling

   D. A tankless water heater providing domestic hot water only

Section Review

Answers for page 14

1. **The tankless water heater's first priority is:**

   A. Maximum Flow B. Set point temperature

   To ensure set point temperature, the tankless water heater can reduce flow

2. **Delta T (ΔT) is the difference between the water heater's set point temperature and incoming water (groundwater). True/False**

   True. *This can affect the water heater's output GPM.*

3. **Which of the following can determine Delta T (ΔT):**

   A. Geographic location (including altitude)

   B. Set point temperature of the water heater

   C. Season of year (summer, winter, etc.)

   D. Source of water supply (municipal as compared to well water)

   E. All of the above

   Along with set point temperature, any factor contributing to incoming water temperature will affect Delta T (ΔT).

Section Review

Answers for page 30

1. **Which of the following is required by Rinnai for the electrical connection of the tankless water heater?**

   A. Local disconnect switch
   B. Dedicated circuit
   C. A properly grounded outlet or circuit
   D. All of the above

   The water heater must be properly grounded through the electrical connection for proper operation. A dedicated circuit and local disconnect switch are not required by Rinnai—these may be required by local code guidelines.

2. **What is the LS series adjustment procedure for high altitude:**

   A. Adjustment of gas manifold pressure
   B. Adjustment of vent length
   C. Adjustment of dip switches
   D. All of the above

   Compensating for high altitude only requires dip switch adjustments at the PCB

3. **If gas lines cannot carry enough volume based on the structure's total Btu load, the only alternative is resizing the gas pipe. (True/False)**

   False. *In many cases, a two stage gas pressure system will compensate for inadequate volume*.

4. **Outdoor units can be installed in unfinished crawlspaces. (True/False)**

   False. *Crawlspaces (and carports) are still enclosures and require indoor units.*

Section Review

Answers for page 45

1. **Double-wall B-vent is approved for Rinnai indoor tankless water heaters. (True/False)**

   False. *No type of B-vent is approved for any current Rinnai tankless water heater*

2. **What is the total allowable vent equivalency of Rinnai indoor tankless water heaters?**

   A. 21 feet
   B. 6 feet
   C. 41 feet
   D. 3 feet

   Total equivalency including all 90° and 45° bends is 41 feet

3. **R98 LSi models have zero clearance from combustibles for the entire vent length. (True/False)**

   False. *The exhaust portion of the R98 LSi must have a 4" clearance if enclosed on four sides or a 1" clearance if enclosed on 3 or fewer sides*

4. **Which of the following vent installations must use the integrated condensate collector?**

   A. Any vertically terminated vent system
   B. Any horizontally terminated vent system
   C. Horizontal vent systems with more than 5' of vertical rise
   D. Horizontal vent systems with two or more bends
   E. A, C and D

   Employing the condensate collector in these installations is very important for proper operation and warranty adherence

Section Review

Answers for page 56

1. **Multiple temperature controllers must be wired in:**

   A. Series B. Parallel

   Parallel. Wiring in series will not allow the proper voltage to each controller.

2. **An MCC-91 temperature controller must be purchased for any commercial application. (True/False)**

   ***False**. If a commercial application does not exceed 140° an MCC-91 is not needed. The commercial warranty will still apply.*

3. **Which of the following are diagnostic features available from MC-91/MCC 91 temperature controllers?**

   A. GPM Flow B. Report of previous error codes

   C. Outgoing water temperature D. A and C

   The above diagnostic tests can be very helpful to ensure proper operation

4. **Which of the following are true statements?**

   A. All indoor Rinnai tankless LS series water heaters come with an MC-91 controller mounted in the front cover

   B. All outdoor Rinnai tankless water heaters come with an MC-91 to be installed remotely

   C. All Rinnai tankless water heaters will operate without a temperature controller at a default temperature of 120° F

   D. All Rinnai tankless water heaters will accept a maximum of four temperature controllers

   E. A, C, and D

   All outdoor units EXCEPT the V53e come with an MC-91. This can be purchased and connected to the V53e at the point of installation.

Section Review

Answers for page 66

1. **Rinnai isolation valve kits are recommended for the following reasons:**
   - A. Ease of service (ability to flow water without structural plumbing)
   - B. Future maintenance (ability to flush water heater)
   - C. Code adherence (installation of properly sized pressure relief valve)
   - D. All of the above

   Rinnai isolation kits (kits are model dependent) provide all of the above benefits

2. **A load bearing header must be installed above all recess boxes. (True/False)**

   False. *In most cases, only the recess box for the R98 LSe water heater will require the installation of a load bearing header*

3. **Which of the below is the recommended accessory for installing two R94 LSi water heaters?**
   - A. An MSA-2M
   - B. An EZConnect™ cable
   - C. A PVA kit

   While an MSA-2M will provide the same performance and benefits, the EZConnect™ cable is the most cost effective accessory for two R94 LSi water heaters

Section Review

Answers for page 75

1. **Which of the following is the correct method of piping when installing two or more Rinnai tankless water heaters in the same plumbing system?**

   A. Parallel plumbing (common hot, common cold)

   B. Series plumbing (hot outlet of one water heater enters the cold inlet of another)

   C. Either of the above

   For proper performance, only pipe Rinnai tankless water heaters in parallel

2. **Circulation of hot water into a Rinnai water heater (as shown in the optional circulation method) can reduce the warranty. (True/False)**

   True. *Circulation that causes hot water to re-enter a Rinnai tankless water heater will reduce the parts and heat exchanger warranty to three years. The preferred method of circulation prevents this reduction of the warranty.*

3. **Rinnai tankless water heaters are approved for use as commercial dishwasher booster heaters (True/False)**

   False*. While Rinnai tankless water heaters can be used as a supply for commercial dishwashers, they should never be used as an initial booster.*

Section Review

Answers for page 83

1. **The warranty for a Rinnai tankless water heater does not apply to which of the following?**
   - A. Acts of God
   - B. Improperly installed units
   - C. Units used in an incorrect application (misapplication)
   - D. Units installed by an individual not licensed or qualified to do so
   - E. All of the above

2. **To reset an error code on a Rinnai tankless water heater:**
   - A. Turn off water
   - B. Turn off power (and turn on again)
   - C. Press the “reset” button on the controller
   - D. Either A or B

   Turning of water or recycling power will clear and reset an error code. There is not a “reset” button.

3. **Where is the location of the inlet water filter on a Rinnai tankless water heater?**
   - A. On the hot water outlet under the unit
   - B. On the cold water inlet under the unit
   - C. Inside the unit

   The inlet water filter is directly under the unit on the cold water inlet.

The End

Rinnai

Tankless Water Heater Training Program

Installation Fundamentals

Level II

Pt. # 100000102 - 1008 Rev 2